PROPELLERS IN A NUT SHELL

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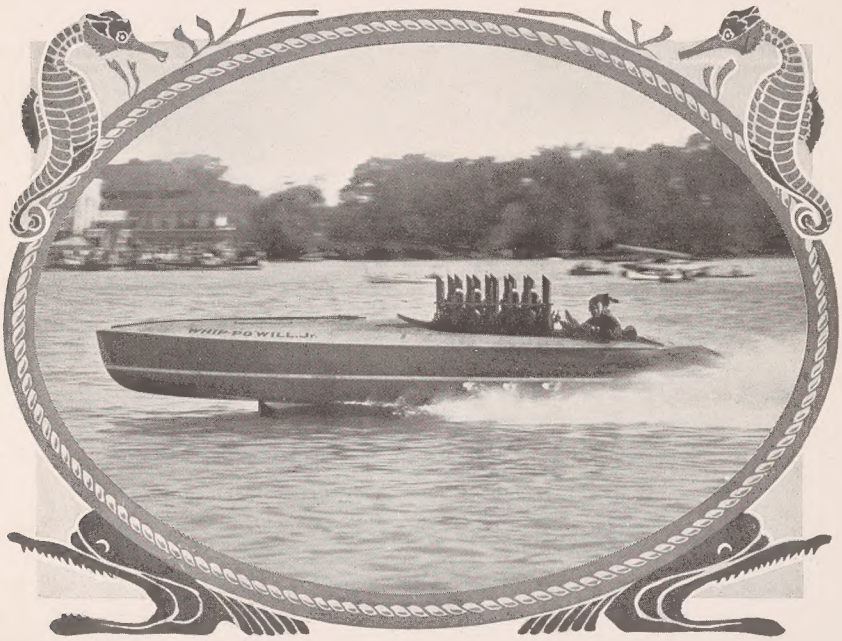

"Whip-Po'Will, Jr."
First Seventy Mile an Hour Boat

Officially timed at Lake George, New York, December, 1917, 70.15 miles per hour. Won Mile Speed Championship at Gold Challenge Cup Races at Detroit, September, 1918. Also won the Canadian International Gold Challenge Trophy and the Great Lakes International Thousand Dollar Gold Cup at Toronto, in September, 1918. Owned by Commodore A. L. Judson. Built by Jack Reebe. Columbian Ailsa Craig Propellers 22 in. x 38 in. Twelve Cylinder Van Blerck Racing Engines.

THE SPEED OF YOUR
BOAT DEPENDS UPON
YOUR PROPELLER

Published by the

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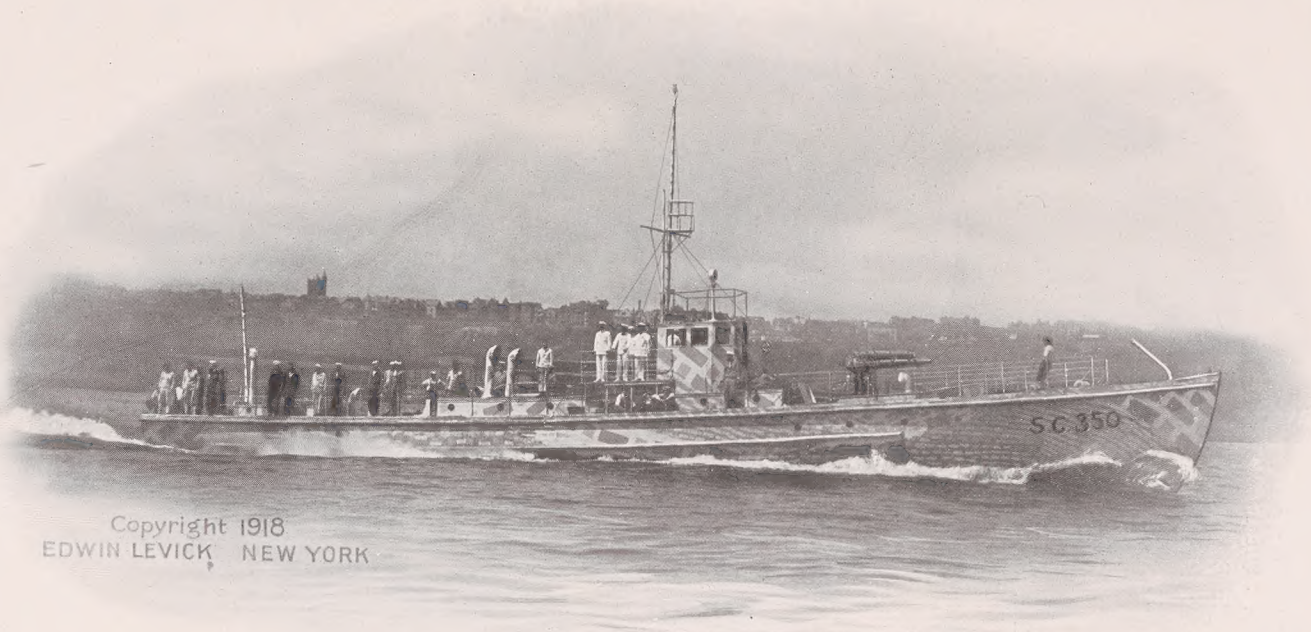
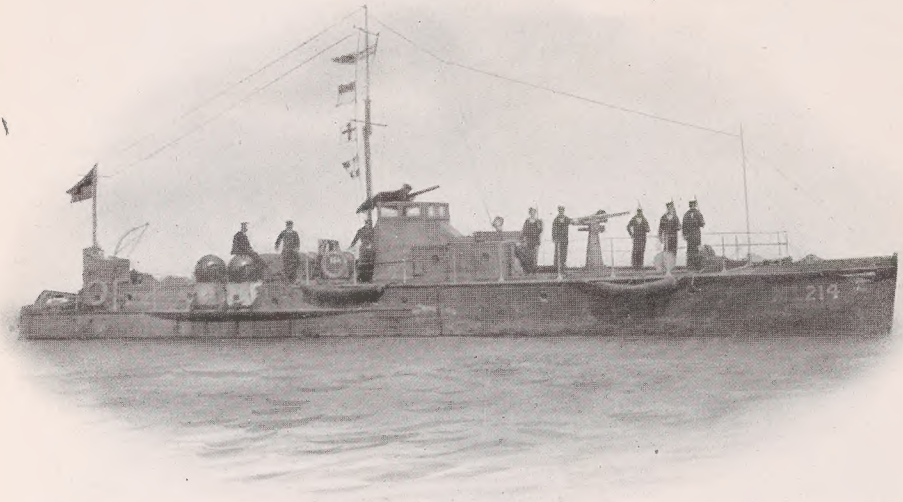


United States 110-Foot Submarine Chaser

Designed by Lt. Com. A. Loring Swasey in conjunction with the Bureau of Construction and Repair of the United States Navy. Officially announced to have sunk more submarines than any other class of boats in the Navy. Over 1,500 propellers designed by Rear Admiral C. W. Dyson for these triple screw boats show the high quality of Columbian workmanship and Columbian Manganese Bronze. This quality is also shown in the propeller shaft struts, bearings, hawse-pipes, rudders and shoes, carried by 130 of these boats. They are all powered with six-cylinder Standard Motors, built by the Standard Motor Construction Company, of Jersey City, New Jersey. This boat was built by the College Point Boat Corporation and is Columbian equipped throughout.



Copyright M. Rosenfeld.

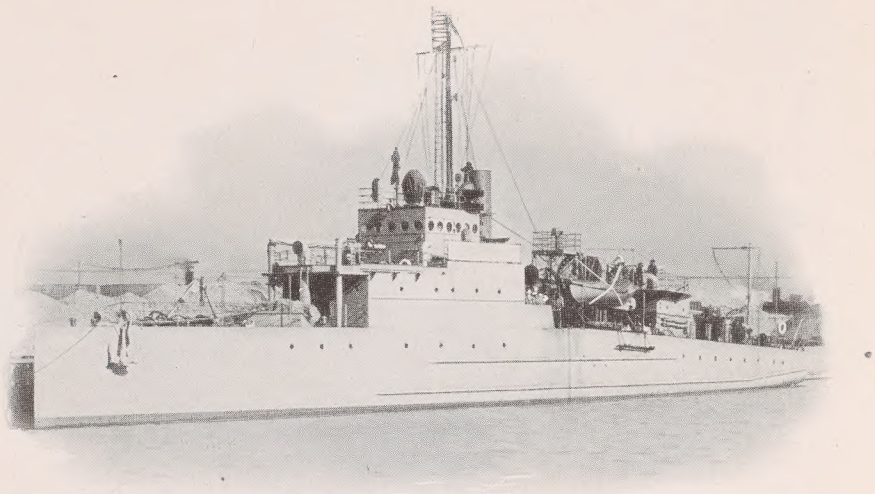
80-Foot British Motor Launches. Speed 20 Knots

Several of these twin-screw boats performed a vital part in the bottling up of the German Submarines at Zeebrugge and Ostend and the total force of 550 boats constituted an important factor in British submarine defense. All of these boats, and over 100 more for the Allied Governments, were equipped with propellers manufactured by the Columbian Bronze Corporation to the specifications of the Elco Company. The boats were built by the Submarine Boat Corporation and powered with six-cylinder Standard Motors.

COLUMBIAN PROPELLERS IN THE WAR

We can point, with pardonable pride, to the fact that with all of the industrial plants in the world to choose from, the Columbian Bronze Corporation was selected for the manufacture of the propellers for the British Motor Launches, the Russian Sixty-Foot Submarine Chasers, the Italian Submarine Chasers (that did such active work in the Mediterranean and sunk an Austrian battleship in Pola Harbor), the United States 110-foot Submarine Chasers, about 80 per cent of the United States Sectional Patrol Boats, the 110 Footers for the French Government, and the castings for the 120 79-inch propellers for the Ford Eagle Patrol Boats, besides a large tonnage of miscellaneous bronze and copper castings for various Government enterprises necessary for the successful prosecution of the war.

There can be no further question as to the supremacy of Columbian Propellers, for the three vital factors, efficiency, accuracy and durability absolutely govern when propellers are purchased by the United States and other Governments in war time. Too many lives are at stake to permit the use of any but the best. The utmost speed is essential in Naval actions, smoothness of running is necessary for the comfort of the crew in the long hours of patrol duty, and reliability at all times is imperative.



Eagle Class Patrol Boat

Built by the Ford Motor Company, Detroit. 120 79-inch propellers for these were cast of Columbian Manganese Bronze.

To meet this demand for high quality, the organization of the Columbian plant has been keyed up to the utmost limits of efficiency, and this rigid training during the long years of the war carries an additional guaranty of quality for Columbian propellers in peace times.

THE IMPORTANCE OF THE PROPELLER

Our slogan, "The speed of your boat depends upon your propeller," is universally conceded to be true. The revolutions and therefore the power of your engine, and the efficiency of your hull are both controlled by your propeller. Your comfort also is controlled by your propeller, for no matter how beautifully your engine and operating mechanism are constructed, a poorly made propeller will cause excessive vibration.

To obtain best results with your boat, the right style of propeller must first be selected. By glancing through this catalog you will note eleven different styles, each one a particular specialty carefully designed for certain work. Some authorities claim that one style is sufficient; that by selecting the proper diameter and pitch of that one style, maximum results can be obtained. One manufacturer will claim this for one style, other manufacturers for other styles, each according to his own line of patterns.

We have proven many times that one style and blade area of propeller will not do. A wide blade propeller, like the Columbian Commercial or the Ailsa Craig, will give greatest efficiency where the resistance is the greatest and where the propeller turns less than 800 revolutions per minute. The narrow blade, Columbian Arrow

Propellers are most efficient on light displacement boats with high-speed engines, and blades of medium width, like the Columbian Rocket or Columbian Architect, on express cruisers and similar boats, equipped with engines turning over eight hundred revolutions per minute.

For commercial work the Columbian Commercial Propeller is the best, as the wide, square blades have the greatest driving power, and are especially powerful in backing. To meet these conditions, and many other variables in propeller installations, many different styles of propellers are necessary and the selection must be carefully made.

Next in importance to the style of propeller is the diameter and pitch. Inasmuch as we have over three thousand different patterns for propeller of different diameters and pitches in our different styles, we are in better position to supply you than is any other manufacturer.

Having selected the right style, diameter and pitch, the next is the point in which Columbians excel above all others, viz.: "Quality." Columbian propellers embody all the little niceties of design which overcome resistance to rotation and skin friction, and reduce slippage to a minimum. In other words, they utilize your power to the best advantage. Columbian quality is further described on page 8.

"Miss Liberty"

52-ft. Express Cruiser owned by Mr. H. Birge, Buffalo, N. Y. Built by Great Lakes Boat Building Corporation. 8-Cylinder Sterling Engines. A 24-inch x 22-inch Columbian Ailsa Craig Propeller drives her 20 miles per hour.

COLUMBIAN QUALITY

When we make the assertion that Columbian Manganese Bronze Propellers are the most perfect Propellers made, we do so advisedly, with a full appreciation of the good qualities of our competitors' products.

Columbian Propellers excel all others in efficiency, speed and power, because the most careful scientific study has developed principles in propeller design not embodied in any other make.

Naval Architects and Engineers are usually very particular about the Propellers they use. They know the advantages gained by using Propellers that are accurately and carefully made, true screw, accurately balanced, and made of bronze of the highest test. Frequently they subject our Propellers to the severest inspection with surface gauge, calipers and balancing device. We welcome these tests, for we know that customers making them are in position to appreciate the quality of genuine Columbian Propellers as compared with others, and that further orders will surely follow.

The principal features of a perfect Propeller are these: **Design, Accuracy as to pitch, Balance as to pitch, Balance as to weight, Workmanship and Material.**

Design.—By "design" is meant not only the outline or shape of the blade, but also the face of the blade, which must force the water aft with the greatest efficiency; the cross sections of the blade, the advancing and leaving edges, and the method of joining the blade to the hub, all of which are designed for the best stream line efficiency —the least possible resistance to rotation. It is this carefulness of design that enables us to so distribute the metal as to obtain the sharp, thin edges, yet with abundance of strength where it is required. Columbian Propellers, therefore, rotate faster with the same power.

Accuracy as to Pitch.—The Columbian method of generating the pitch from a Master Helix (screw-thread) in making the patterns has no equal. The pitch is accurate; it cannot be otherwise. This is a most important point. The engine manufacturer must have the pitch he orders, or his engine will run too fast or too slow. The naval architect's data is all wrong if the pitch is not what he thinks it is.

Balance as to Pitch.—This means having the pitch the same on every blade of the Propeller, and the same at every point on each blade. This is a most difficult thing to obtain. It is impossible without our Pitch Generating Machine. If the pitch is not balanced a loss in efficiency and excessive vibration result.

Balance as to Weight.—Each Columbian Propeller is accurately balanced. Its blades are all equal in weight. This prevents vibration and excessive wear on the stern bearing.

Workmanship.—To retain in the finished propeller the accuracy and carefulness of the design of the pattern, the most careful workmanship must be employed together with a most rigid system of inspection. The Columbian organization of skilled workmen is the result of years of development and training.

Material.—All Columbian Propellers are made of Columbian Manganese Bronze, which is equal to any manganese bronze made. It is non-corrosive in salt water and is exceedingly strong. The following tests were made in Dr. Charles F. McKenna's Laboratory, New York City:

	Test No. 0 lbs.	Test No. 1 lbs.	Test No. 19 lbs.	Test No. 21 lbs.
Breaking strength per sq. inch.....	76,000	74,500	70,050	71,750
Elastic limit per square inch..... (Pull required to start stretching)	38,000	36,000	35,600	36,750
Elongation in two inches..... (Amount of stretch before breaking)	30%	26%	39%	37%

Manganese Bronze used in Propellers for the United States Navy must show a breaking strength of at least 65,000 lbs. per square inch, and elongation not less than 20 per cent. Columbian Manganese Bronze exceeds these requirements.

Patents.—The Columbian Pitch Generating Machine used in making Columbian Propeller Patterns, and also used in checking the accuracy of Columbian Propeller Castings, is fully protected by basic United States Letters Patent.

The Columbian exclusive method of making Columbian Propeller Patterns is also fully protected by basic United States Letters Patent. Infringers will be prosecuted.

TERMS

Please Read Carefully

All bills as rendered show net prices.

Unless otherwise definitely stated, all prices are F. O. B. Freeport.

Unless Credit arrangements have been made, cash must accompany all orders.

Unfortunate experiences have forced us to require a deposit in advance on all C. O. D. orders.

This makes it impossible to ship telegram orders C. O. D. unless customers are known to us.

Remit by Post Office or Express Money Order, Draft, Postal Note or Check on your local bank.

All goods are carefully packed and shipped in good order. No charge for boxing or crating.

We are glad to make Credit arrangements when customers are satisfactorily rated in Dun's or Bradstreet's or upon receipt of suitable references.

We stand back of all Columbian products and will make good if not as represented in our guarantee. We request our customers to write us at 50 Church Street, New York City, about any complaint and to hold the goods until our reply is received.

If goods are returned, they should be shipped to our plant at Freeport, Long Island, New York and not to our New York Office. Express or freight charges must be prepaid. Mark your name plainly on the box and also on the goods and write us, sending express or freight receipt and stating why goods are returned.

REFERENCE BANKS

Metropolitan Trust Company, New York City.

Fidelity Trust Company, New York City.

The Freeport Bank, Freeport, New York.

A TRADE MARK AND A GUARANTEE

This trade-mark is stamped on the hub of every genuine Columbian Propeller. It is registered in the Patent Office at Washington, D. C., and means that the wheel is a genuine high-grade Columbian Propeller, made by the Columbian Bronze Corporation of 50 Church Street, New York. It also means that it is guaranteed to be made of Columbian Manganese Bronze, strong, sound

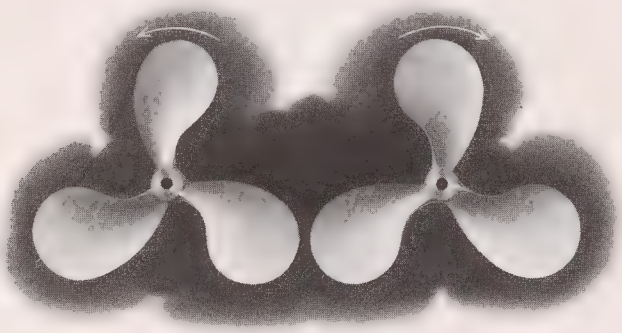
and clear of defects, that the blades are true and of the pitch represented, and that the workmanship is accurate.

This trade mark on other Columbian products means that they also are guaranteed to be as represented in our catalog, that the metal is strong, sound and clear of defects, and that the workmanship is accurate.

If not as represented, any Columbian product bearing this trade mark may be returned to us within one year from date of purchase, and we will repair it and place it in as good condition as originally represented, or we will replace it without charge, **providing** it is returned with express or freight charges prepaid.

ROTATION OF PROPELLER

Be Sure and State Whether Right or Left Hand Wheel is Wanted

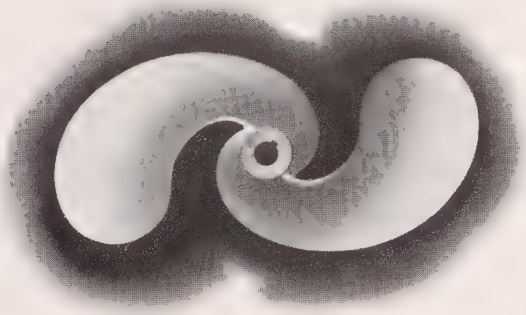


Left Hand **Right Hand**

The above show the directions in which the wheels revolve when you stand on the ground behind the boat and look at the propeller in position under the stern. If the propeller revolves in the same direction as the hands of a clock to force the boat ahead, it is right hand. If it revolves in the opposite direction to the hands of a clock, it is left hand.

When you stand in the boat forward of the engine, facing the stern of the boat, if the propeller shaft turns in the same direction as the hands of a clock, a left hand propeller is required to force the boat ahead. If the propeller shaft turns in the opposite direction to the hands of a clock, a right hand propeller is required.

The propeller should be installed with the rounding or convex side of the blade toward the engine, the flat side facing aft.



Style C. Fig. 50
Columbian Speed Weedless

We guarantee this propeller to be "weedless." It will clear itself of weeds, eel grass, water hyacinth and other marine growths while running. Any weeds the boat will go through, this propeller will pass without fouling. If the wheel fails to throw off the weeds and stops the engine it may be returned and we will refund your money.

Although the weedless propeller is not true-screw, it is an excellent speed wheel, having won several prizes in races, and on small boats is also good for towing. In fact, owing to its weedless qualities it is a good all-around wheel, as it will go anywhere without causing annoyance.

Care should be taken that weeds cannot accumulate around the propeller shaft forward of the propeller, and the rudder should be tapered off on its forward edge below the propeller shaft so the weeds will pass under the rudder.

2-Blade Weedless propellers are made in diameters from 10 inches to 30 inches.

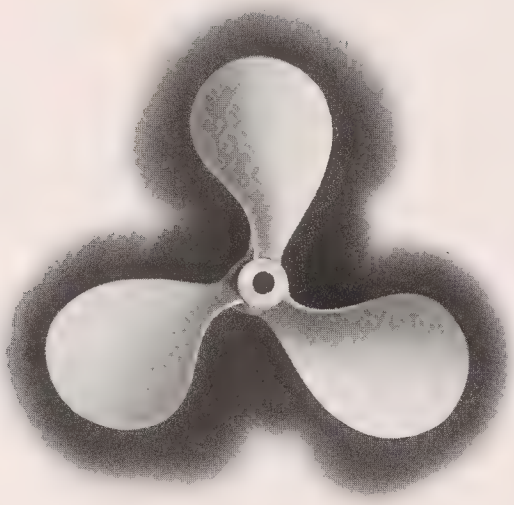
3-Blade Weedless propellers are made to order only from 22 inches diameter up. Prices upon application.

BRONZE POLISHED, 2-BLADE

Diameter	Price Not Bored	Extra for Boring	Pitch Ratio 1.25	Pitch Ratio 1.5
10 inch	$4.00	$1.00	12½ inch	15 inch
12 inch	5.50	1.00	15 inch	18 inch
14 inch	7.00	1.40	17½ inch	21 inch
16 inch	9.50	1.60	20 inch	24 inch
18 inch	11.50	1.80	22½ inch	27 inch
20 inch	15.00	2.00	25 inch	30 inch
22 inch	18.00	2.30	27½ inch	33 inch
24 inch	23.00	2.60	30 inch	36 inch
26 inch	28.00	3.00	32½ inch	39 inch
28 inch	34.00	3.40	35 inch	42 inch
30 inch	43.00	3.80	37½ inch	45 inch

Propellers with pitches other than the above will be made to order.

Be sure and state whether right or left hand wheel is wanted. **See page 11.**



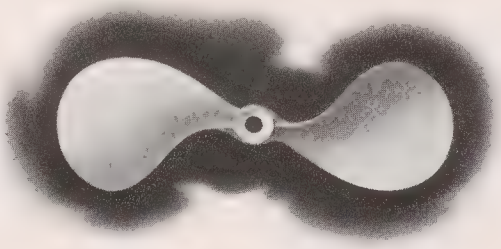
Style A. Fig. 20
Columbian Reliance Propeller

The original Columbian Speed Propeller which started the Columbian reputation, winning seven championships the first year. It is one of the fastest wheels made, and is very efficient for all types of boats.

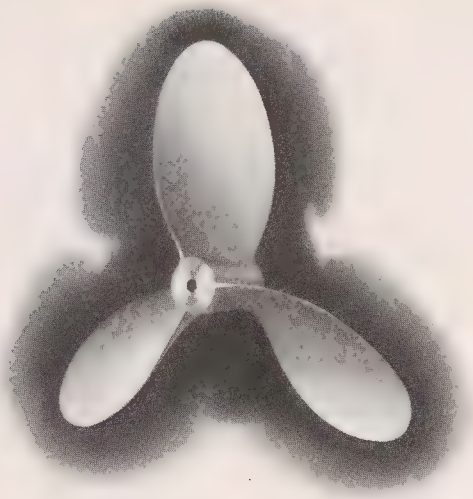
Many authorities maintain that the most important working surface of a propeller is located about two-thirds of the distance out from the hub; that the greatest driving effort is exerted from that point to the end of the blade, and that the portion toward the hub develops comparatively little driving power and should therefore be designed merely for strength and to offer the least possible streamline resistance.

This propeller is designed on those principles and its efficiency supports the claims made for it.

They are furnished with any ordinary pitch. For blade areas see page 20, for prices see page 19.



Style A. Fig. 10
Columbian Reliance Propeller



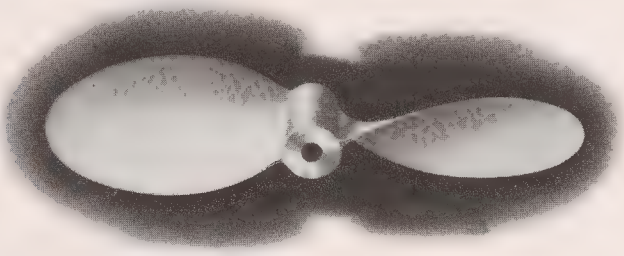
Style E. Fig. 40
Columbian Arrow Propeller

COLUMBIAN ELLIPTICAL BLADE PROPELLERS

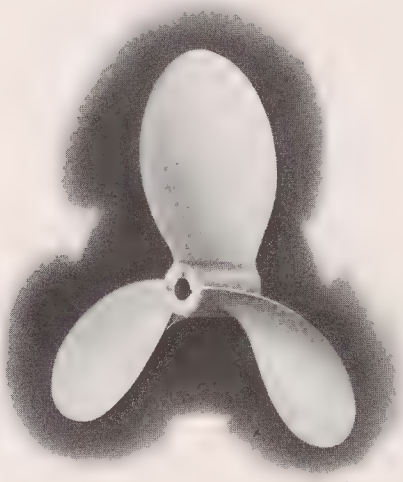
For prices see page 19. For blade areas see page 20.

The Columbian line of true-screw Elliptical blade propellers, comprising as it does, four different styles, the Columbian Arrow Propeller, the Columbian Rocket Propeller, the Columbian Architects Propeller and the Columbian Ailsa Craig Propeller, is so complete in its range that it offers a suitable propeller—diameter, pitch and blade area—for any motorboat.

Each one of these styles has made a reputation of which we are justly proud. They embody in their design the most modern principles of propeller efficiency and the workmanship is what the most



Style E. Fig. 30
Columbian Arrow Propeller



Style G. Fig. 90
Columbian Rocket Propeller

fastidious naval architect would obtain if a workman under his personal instruction and supervision were to produce the finest propeller of which he could conceive.

We believe we have made it impossible for any designer to produce a special propeller for any individual boat that will give better results than a propeller we may select from one of our own stock patterns.

The elliptical shape of propeller blades is favored generally by Naval Architects, and propeller designers, because the blades are of simple outline, symmetrical and geometrical. The contour offers a smooth curve at every point, without sharp angles, and permits the advancing edge to offer the least possible resistance in cutting the water, and the leaving edge to allow the water to close over it with a minimum possibility of cavitation.

The blade area both expanded and projected can be figured by a well known geometrical formula with an easily ascertained allowance for the construction at the hub. The greater portion of the area of the blade is distributed symmetrically around the center, and the area diminishes near the end of the blade, thus offering less resistance to rotation. For this reason the Columbian Ailsa Craig propeller of the same diameter, pitch and of slightly greater blade area will rotate faster with the same power than the Columbian Commercial propeller, with square end blades. On a boat that is easily driven this would increase the speed, but for driving against head winds or other great resistance the square end blade might give better results.

Style F. Fig. 80
Columbian Architects Propeller

COLUMBIAN ARROW PROPELLERS, STYLE E

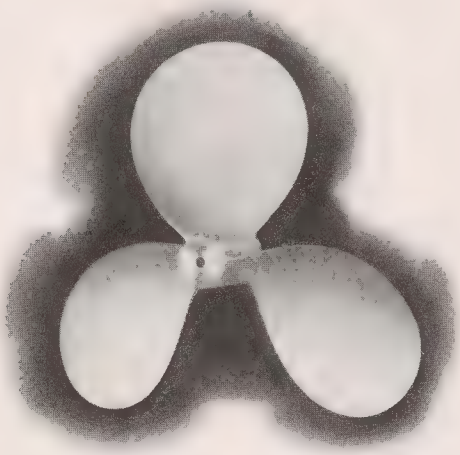
Narrow blade propellers of this type are best suited for light easily driven boats such as displacement speed boats, and light runabouts with high speed engines. They are also used frequently on heavier boats with high speed engines with too little power. In that case a propeller of large diameter and low pitch is required, and the narrow blades permit a larger diameter for the same power, giving better results. The greatest width of blade is 25 per cent of the diameter.

COLUMBIAN ROCKET PROPELLERS, STYLE G

These propellers have been used to good advantage on high speed engines in displacement racers, express cruisers, day cruisers, runabouts and V bottom boats. Wherever an engine is installed turning over 600 revolutions per minute, the Columbian Rocket Propeller should be considered. The greatest width of blade is 29 per cent of the diameter.

COLUMBIAN ARCHITECTS' PROPELLER, STYLE F

This propeller made its reputation on high powered displacement racers, winning many championships. It was designed to meet the demands of prominent Naval Architects and follows somewhat but



Style I. Fig. 110
Columbian Ailsa Craig Propeller

not entirely the construction of the Thornycroft propeller, the hub being long and the blade width following well down to the hub.

It is an exceptionally efficient propeller on any installation turning from 600 to 1,400 revolutions per minute. With the same power it turns somewhat slower than either the Rocket or Ailsa Craig propeller, but there is maximum driving power in every revolution. The greatest width of blade is 33-1/3 per cent of the diameter.

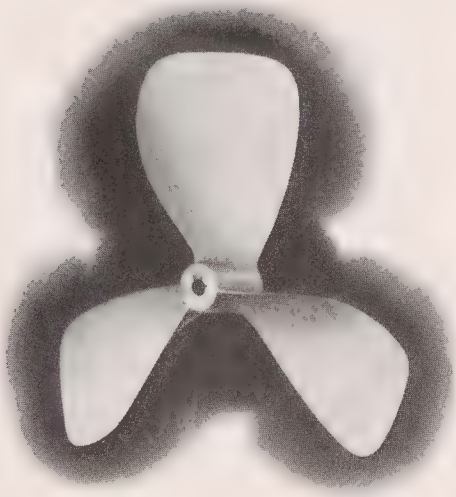
COLUMBIAN AILSA CRAIG PROPELLER, STYLE I

This propeller is modelled largely after the one used by the Bermuda Racing Cruiser "Ailsa Craig" when she won the first race to Bermuda in the remarkable time of 65 hours and 39 minutes.

In recent tests made with propellers of the same diameter and pitch at the same number of revolutions, on the same boat, these wheels proved more efficient turning 600 r.p.m. than any other propellers made except the Columbian Style "H."

We recommend these propellers for yachts having engines turning less than eight hundred revolutions per minute.

The greatest width of blade is 40 per cent of the diameter up to 36-inch diameter, but less for larger sizes. See page 20.



Style H. Fig. 100
Columbian Commercial Propeller

We claim these propellers to be the most efficient made anywhere for heavy boats with engines turning less than six hundred revolutions per minute, on boats operating against strong tides, currents or in rough weather, or against strong head winds, or for boats used for towing.

For that service we have never found any propellers of the same diameter and pitch and with approximately the same blade area, or less blade area, that would equal them in either speed or power.

They are also the most powerful propellers we make for backing.

They are true screw and are designed on the principles of the Columbian Reliance propellers combined with the more efficient cross-section of that portion of the blade near the hub embodied in the elliptical blade propellers.

COLUMBIAN TOWING PROPELLERS. STYLE B. FIG. 60

These propellers, with narrower blades, embody the same features as the Columbian Commercial Propellers. They are used for the same service on boats where a large diameter is desired, but equipped with engines not powerful enough to turn the Columbian Commercial Propellers the required number of revolutions per minute.

For illustration see page 46.

PROPELLER PRICES

The price list covers propellers of the following styles which are made only in the following diameters:

Style A—2-Blade 10 inches to 30 inches, 3-Blade 10 inches to 36 inches.

Style E—2-Blade 10 inches to 30 inches, 3-Blade 10 inches to 36 inches.

Style G—3-Blade only 12 inches to 36 inches.

Style F—3-Blade only 12 inches to 36 inches.

Style I—3-Blade only 12 inches to 50 inches.

Styles B and H—3-Blade only 22 inches to 50 inches.

Two Blade Diameter	Not Bored	Extra for Boring	Three Blade Diameter	Not Bored
10 inch	$3.00	$1.00	10 inch	$4.00
12 inch	3.80	1.00	12 inch	5.50
14 inch	4.80	1.40	14 inch	7.00
16 inch	6.50	1.60	16 inch	9.50
18 inch	8.25	1.80	18 inch	11.50
20 inch	11.00	2.00	20 inch	15.00
22 inch	13.50	2.30	22 inch	18.00
24 inch	16.00	2.60	24 inch	23.00
26 inch	20.00	3.00	26 inch	28.00
28 inch	25.00	3.40	28 inch	34.00
30 inch	33.00	3.80	30 inch	43.00
32 inch		4.40	32 inch	52.00
34 inch		5.20	34 inch	59.00
36 inch	**Propellers of**	6.00	36 inch	65.00
38 inch	**odd diameters**	7.00	38 inch	78.00
40 inch	**made to order.**	8.00	40 inch	100.00
42 inch	**Prices same as**	9.00	42 inch	108.00
44 inch	**next larger**	10.00	44 inch	126.00
46 inch	**even diameters**	12.00	46 inch	150.00
48 inch		15.00	48 inch	176.00
50 inch		19.00	50 inch	195.00

Columbian Propellers are all true screw and made of Manganese Bronze, polished and guaranteed as shown on page 10. Propellers larger than 32 inches in diameter are not always buffed. All of these styles are furnished with any ordinary pitch. Blade areas are shown on page 20. Hub dimensions on page 21.

Be sure and state whether right or left hand wheel is wanted. See page 11.

BLADE WIDTHS AND AREAS

Greatest Width of Blade	Approximate Expanded Blade Area Square Inches. Note:—Where no areas are shown, sizes are not made except on special order. Prices upon application.									
	2-Blade		3-Blade							
	Style E	Style A	Diam.	Style I	Style F	Style G	Style E	Style A	Style H	Style B	Diam.
Style E ¼ of the diameter	18	21	10 in.	40			27	32			10
" B 27% " " "	24	30	12 in.	58	49	46	36	45			12
" G 29% " " "	34	42	14 in.	79	70	64	52	63			14
" F 1/3 " " "	46	52	16 in.	103	93	83	70	78			16
" H 1/3 " " "	60	66	18 in.	132	120	105	90	99			18
" A Approximately 1/3 of the diameter.	74	84	20 in.	163	150	130	112	126			20
	90	106	22 in.	197	180	157	136	159	180	163	22
" I 40% of the diameter for diameters 36 inches and under. Larger diameters as follows:	106	128	24 in.	233	210	188	162	193	212	177	24
	126	152	26 in.	274	240	220	189	229	247	207	26
	146	178	28 in.	320	280	256	219	267	290	243	28
	168	203	30 in.	366	315	294	253	309	340	278	30
38"—14.4"			32 in.	414	380	342	287	353	390	316	32
40"—14.4"			34 in.	470	433	387	325	399	440	360	34
42"—14.4"			36 in.	528	483	427	363	451	490	407	36
44"—14.6"			38 in.	585					545	453	38
Larger diameters 1/3 of the diameter.			40 in.	639					600	511	40
			42 in.	681					660	528	42
			44 in.	729					730	627	44
			46 in.	789					800	654	46
			48 in.	860					870	756	48
			50 in.	933					915	762	50

DIMENSIONS OF HUBS OF COLUMBIAN PROPELLERS

These Dimensions Cover Both Two and Three-Blade Propellers

If special hubs are required a slight extra charge may be made. Odd diameters up to 21 inches are made to order only. Hub dimensions and prices are the same as the next larger even diameter.

Propeller Diam. Inches	Hub Diam. Inches	Largest Diam. Tapered Shaft Permissible for Safety Inches	LENGTH OF HUB			
			Styles A, B, C, E and H Inches	Style I Inches	Style F Inches	Style G Inches
10	1 3/16	3/4	1 7/8	1 7/8		2 1/8
12	1 3/8	7/8	2 1/8	2 1/8		2 3/8
14	1 5/8	1	2 3/8	2 5/8	3	2 11/16
16	1 13/16	1 1/4	2 5/8	2 15/16	3 1/2	3
18	2	1 3/8	3	3 1/4	3 7/8	3 3/8
20	2 1/4	1 1/2	3 3/8	3 9/16	4 1/4	3 3/4
22	2 1/2	1 3/4	3 5/8	3 7/8	4 5/8	4 1/8
24	2 3/4	1 7/8	4	4 1/4	5	4 1/2
26	3	2	4 3/8	4 5/8	5 3/8	4 7/8
28	3 1/4	2 1/8	4 3/4	5	5 3/4	5 1/4
30	3 1/2	2 1/4	5 1/8	5 3/8	6 1/8	5 5/8
32	3 3/4	2 1/2	5 1/2	5 3/4	6 1/2	6
34	4	2 5/8	5 7/8	6 1/8	6 7/8	6 3/8
36	4 1/4	2 3/4	6 1/4	6 1/2	7 1/4	6 3/4
38	4 1/2	2 7/8	6 5/8	6 7/8		
40	4 3/4	3	7 1/8	7 1/4		
42	5	3 1/8	7 3/4	7 5/8		
44	5 1/4	3 1/4	8 1/4	8		
46	5 1/2	3 3/8	8 3/4	8 3/8		
48	5 3/4	3 1/2	9 1/4	8 3/4		
50	6	3 3/4	9 5/8	9 1/8		

COLUMBIAN MOTORSHIP PROPELLERS

Hub Dimensions Are the Same on All Styles

Propeller Diam. Inches	Hub Diam. Inches	Length of Hub Inches	Largest Diam. Tapered Shaft Permissible for Safety Inches
52	7 7/16	10 3/8	4 1/2
54	7 3/4	10 3/4	4 5/8
56	8	11 1/16	4 7/8
58	8 1/4	11 1/2	5
60	8 9/16	12	5 1/8
62	8 7/8	12 3/8	5 3/8
64	9 1/8	12 13/16	5 1/2
66	9 7/16	13 1/16	5 5/8
68	9 3/4	13 5/8	5 7/8
70	10	14	6
72	10 1/4	14 7/16	6 1/8
74	10 1/2	14 3/4	6 3/8
76	10 7/8	15 1/16	6 1/2
78	11 1/8	15 5/8	6 5/8
80	11 7/16	16	6 7/8
82	11 3/4	16 3/8	7
84	12	16 13/16	7 1/4
86	12 1/4	17 1/16	7 3/8
88	12 1/2	17 9/16	7 1/2
90	12 7/8	18	7 3/4
92	13 1/8	18 7/16	7 7/8
94	13 7/16	18 3/4	8
96	13 3/4	19 7/16	8 1/4

COLUMBIAN STUFFING BOXES FOR MOTOR BOATS
For Larger Sizes Ask for Columbian Motorship Catalog

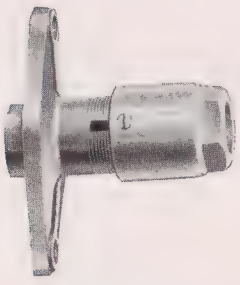


Fig. 150
Lock Stuffing Box

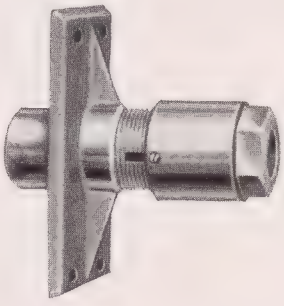


Fig. 155
Square Flange Stuffing Box

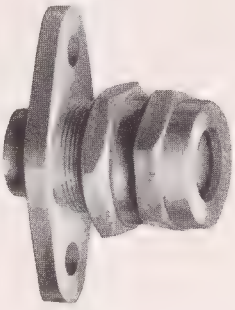


Fig. 160
Plain Stuffing Box

Fig. 150. Lock Stuffing Box.—This has a bronze set-screw in the cap which seats in the groove in the box and positively locks the cap in position. It also contains a washer which prevents the packing from being twisted as the cap is screwed on. If the ordinary lock nuts are preferred, they will be furnished without extra charge.

These stuffing boxes have long bearings, with plenty of room for packing, and large thick flanges. They are made extra heavy of the best anti-friction metal and will stand the wear and tear. When once packed they will never work loose and require no further attention. Price list below.

Fig. 155. Square Flange Stuffing Box.—These Stuffing Boxes are the heaviest and most substantial on the market. Note the weights in the list below. The construction is similar to Fig. 150, with lock-cap and washer, and the material is the best money can buy. For heavy commercial boats these have no equal. Babbitt lined unless ordered solid bronze. If the ordinary lock-nuts are preferred, they will be furnished without extra charge.

Size	1½ in.	1¾ in.	2 in.	2¼ in.	2½ in.	2¾ in.
Approx. Weight	9 lbs.	14½ lbs.	18 lbs.	22¾ lbs.	27¾ lbs.	38 lbs.
Price	$8.70	$17.50	$25.50	$30.50	$37.00	$50.00
Size Bolts Required	⅝	⅝	⅝	⅝	¾	¾

For fitting Stuffing Box to stern tube add one-sixth of price.

Fig. 160. Plain Stuffing Box.—This Stuffing Box is made of good bearing metal, and in the smaller sizes makes a very serviceable article. It is similar to that listed by other makers as "Heavy Pattern."

Size	Fig. 150 Weight	Fig. 150 Price	Fig. 160 Weight	Fig. 160 Price	Size of Bolts Required
⅝ in.	1¼ lbs.	$1.85	⅞ lb.	$1.30	⅜ in.
¾ in.	1¼ lbs.	2.10	1 lb.	1.40	⅜ in.
⅞ in.	2 lbs.	2.60	1¼ lbs.	1.70	⅜ in.
1 in.	2¾ lbs.	3.40	1½ lbs.	1.90	½ in.
1⅛ in.	3⅛ lbs.	3.70	2 lbs.	2.30	½ in.
1¼ in.	4⅜ lbs.	5.00	2⅜ lbs.	2.60	½ in.
1⅜ in.	5½ lbs.	5.90	3 lbs.	3.60	½ in.
1½ in.	7⅝ lbs.	7.50	3⅜ lbs.	4.00	⅝ in.
1¾ in.	13 lbs.	16.00	5½ lbs.	8.00	⅝ in.

For fitting Stuffing Box to stern tube add one-third of price.

COLUMBIAN STERN BEARINGS FOR MOTOR BOATS

For Larger Sizes Ask for Columbian Motorship Catalog

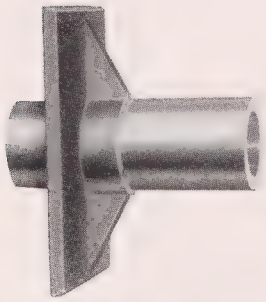


Fig. 156
Square Flange Stern Bearing

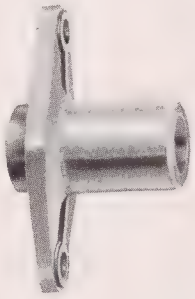


Fig. 170
Heavy Stern Bearing

Size	Fig. 170 Weight	Price	Size of Bolts Required
¾ in.	¾ lb.	$1.15	⅜ in.
⅞ in.	1⅛ lbs.	1.30	⅜ in.
1 in.	1⅝ lbs.	1.60	½ in.
1⅛ in.	1⅞ lbs.	1.90	½ in.
1¼ in.	2⅞ lbs.	2.60	½ in.
1⅜ in.	4½ lbs.	3.60	½ in.
1½ in.	6¾ lbs.	5.60	⅝ in.
1¾ in.	9¼ lbs.	9.60	⅝ in.

For fitting Stern Bearings to stern tubes add ⅓ of price.

Fig. 170. Heavy Stern Bearing.—This is of the same quality as the Fig. 150 Stuffing Box. The weights offer a basis for comparison with Stern Bearings ordinarily sold.

Fig. 156. Square Flange Stern Bearing Babbitted.—Like the Fig. 155 Stuffing Box this is for the heavier class of boats where durability and reliability are required. It is a "Trouble Saver." Higher in first cost, but lower in maintenance. One unnecessary hauling out saved, more than pays for heavy bearings.

Size	1½ in.	1¾ in.	2 in.	2¼ in.	2½ in.	2¾ in.
Approx. Weight	7½ lbs.	12 lbs.	16 lbs.	19½ lbs.	24 lbs.	32 lbs.
Price	$7.00	$14.00	$20.50	$25.00	$30.00	$40.00
Size Bolts Required	⅝ in.	⅝ in.	⅝ in.	⅝ in.	¾ in.	¾ in.

For fitting Stern Bearing to Stern Tube add one-sixth of price.

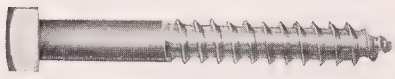


Fig. 201. Lag Screws—Cast Manganese Bronze

Size	Price
⅜ in. x 3 in. each	$.20
½ in. x 4 in. "	.34
⅝ in. x 5 in. "	.60
¾ in. x 6 in. "	.90
1 in. x 8 in. "	1.60

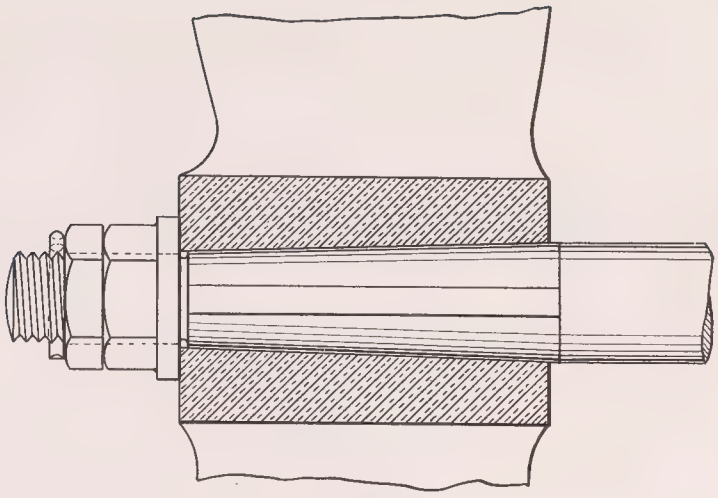
Fig. 202. Hanger Bolts—Cast Manganese Bronze

Size	Price
⅜ in. x 3 in. long under nut	$.34
½ in. x 4 in. " " "	.44
⅝ in. x 5 in. " " "	.75
¾ in. x 6 in. " " "	1.10
1 in. x 8 in. " " "	1.90

TAIL NUTS

Manganese Bronze Tail Nuts can be furnished separately in sizes and at prices listed on page 24.

For Bronze Set Screws and Brass Cotter Pins see page 26.



Columbian Standard Propeller Shaft Mount

Taper ¾-in. diameter per foot for shafts 3 inches diameter or smaller. For shafts larger than 3 inches diameter the taper is 1 inch diameter per foot.

PROPELLER SHAFTING

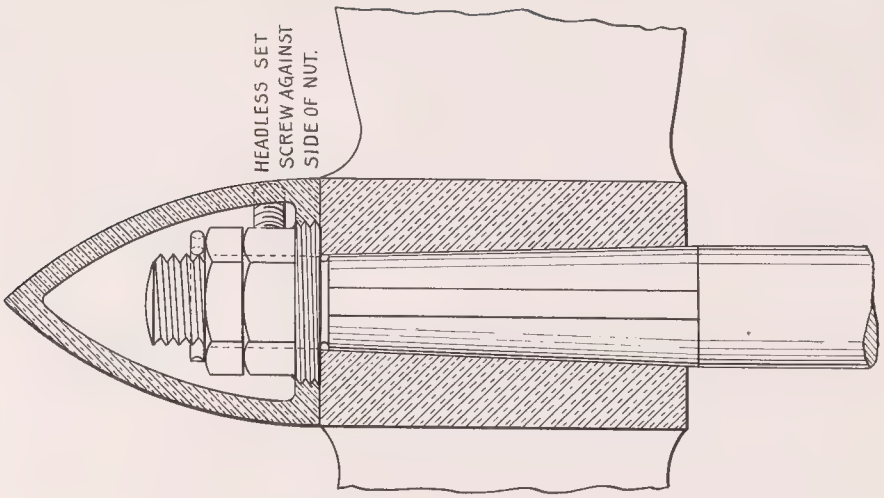
For Larger Sizes Ask for Columbian Motorship Catalog

Prices Per Foot Steel	Prices Per Foot Bronze	Diameter, Inches	Tapering, Threading, Keyseating and Fitting to Propeller		Manganese Bronze Lock Nuts: Diameter Screw	Threads Per Inch	Price Per Pair
Prices upon Application		½	$1.00	Not Tapered	½	12	$.40
		⅝	1.15		⅝	11	.45
		¾	1.55		½	12	.40
		⅞	1.80		⅝	11	.45
		1	1.95		¾	10	.60
		1⅛	2.25		¾	10	.60
		1¼	2.60		⅞	9	.90
		1⅜	2.95		1	8	1.00
		1½	3.40		1⅛	7	1.30
		1⅝	3.85		1¼	7	1.50
		1¾	4.25		1¼	7	1.50
		1⅞	4.65		1½	6	2.15
		2	5.00		1½	6	2.15
		2¼	7.50		1¾	5	3.85
		2½	9.00		1¾	5	3.85
		2¾	10.00		2	4½	5.80
		3	11.50		2¼	4½	7.00
		3¼	12.75		2½	4	9.60
		3½	15.00		2½	4	9.60
		3¾	17.00		2¾	4	11.60
		4	21.00		3	3½	12.70

Unless otherwise ordered propeller is secured by two lock-nuts and a cotter pin, as shown above.

If propeller is bored with straight hole and set screws, no charge is made for fitting shaft. If bored with straight hole with straight key and without nut, the price for fitting is one-third of the above.

For keyway on engine end of shaft add 90 cents.



Columbian Fairwaters. Fig. 196

Bronze Fairwater Tail Nuts designed to S. A. E. standards; adapted to the diameter of the standard hubs of Columbian Propellers.

Specify diameter of propeller hub, diameter of shaft screw thread, number of threads per inch and whether right or left hand thread; otherwise Fairwater will be shipped with nuts not threaded.

Diameter Fairwater, Inches	Fits Columbian Propeller, Diameter	Price Each	Diameter Fairwater, Inches	Fits Columbian Propeller, Diameter	Price Each	Diameter Fairwater, Inches	Fits Columbian Propeller, Diameter	Price Each
1 3/16	10	$2.00	2¾	24	$4.60	4½	38	$10.60
1⅜	12	2.15	3	26	5.30	4¾	40	12.00
1⅝	14	2.40	3¼	28	5.80	5	42	14.00
1 13/16	16	2.60	3½	30	6.30	5¼	44	15.00
2	18	3.00	3¾	32	7.00	5½	46	18.00
2¼	20	3.40	4	34	8.00	5¾	48	19.50
2½	22	3.80	4¼	36	8.80	6	50	21.00

VEEDER REVOLUTION COUNTER

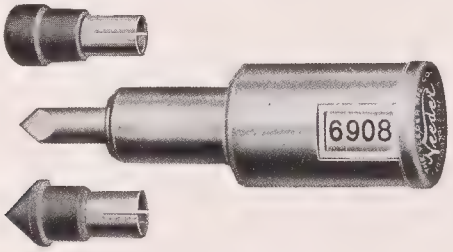


Fig. 185

Fig. 185 may be held in position at center of shaft without counting. Pressure against shaft compresses an internal spring, engaging the clutch and starting the counter, which operates as long as pressure continues. This avoids the necessity of "finding" center of shaft at instant timing is to start. Price $3.85.

Fig. 195 counts the instant it engages shaft. Price $1.85 net.

COLUMBIAN STANDARD PROPELLER SHAFT TAPERS

The standard Propeller shaft tapers were adopted by the National Association of Engine and Boat Manufacturers in 1914. Later the work of the Standards Committee of the Association was taken over by the Marine Division of the Standards Committee of the Society of Automotive Engineers, who quite radically revised the National Association Standards in March, 1918.

We adopted the National Association Standards in 1914 and have used them constantly. We have also adopted the revised standards of the Society of Automotive Engineers with the exception of certain minor details.

For shafts 3 inches diameter or smaller the Standard Taper is ¾-inch diameter per foot, which is equivalent to 1/16 inch per inch.

For shafts larger than 3 inches diameter the Standard Taper is 1-inch diameter per foot, which is equivalent to 1/16 inch in ¾ of an inch.

The basis for the length of taper is three times the diameter of the shaft, and the diameter of the small end of the hole in the propeller hub corresponds to that length of taper.

The actual length of taper on the shaft is made slightly shorter than three times the diameter to permit the tail nut to be screwed tight without striking the shoulder at the end of the taper.

In the Columbian Standards the diameter of that portion of the shaft which is threaded for the tail nuts is larger than the S. A. E. Standards, for greater strength and to minimize machining.

The lengths of the threaded portion are also greater to allow for two tail nuts and cotter pin, whereas the S. A. E. Standard shows only one tail nut and a small set screw for shafts up to 3 inches in diameter.

The standard measurements of Columbian Propeller hubs are shown on page 21.

Propellers bored to the Columbian Standards will fit the S. A. E. standard shafts, but Columbian Fairwaters and tail nuts will not fit S. A. E. standard shafts unless made special.

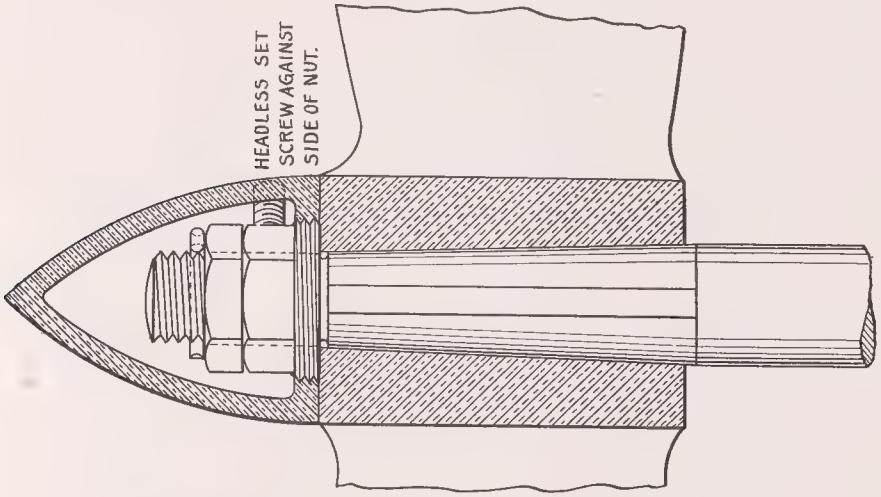
Cast Manganese Bronze Set Screws

Size	Per Doz.
⅜ in. x ¾ in., Square Head	$.45
½ in. x ¾ in., " "	.85

Split Brass Cotter Pins

Size	Per Doz.
5/16 in. x 2 in	$.60
¼ in. x 3 in	1.60

COLUMBIAN STANDARD PROPELLER SHAFT TAPERS



Dimensions of Columbian Propeller Mounts

All dimensions are in inches. Tapers for 3-inch shafts or smaller, ¾ inch per foot; $\frac{1}{16}$ inch per inch. Tapers for larger shafts, 1 inch per foot; $\frac{1}{16}$ inch in ¾ inch.

Shaft Diameter	Diameter Hole in Propeller Hub Small End	Diameter Shaft Taper at Small End	Length of Taper	Keyway Width	Keyway Depth	Diameter Thread on Shaft	Number Threads Per Inch U. S. S.	Length of Threaded Portion
¾	0.609	0.617	2⅛	$\frac{3}{16}$	$\frac{3}{32}$	½	12	⅞
⅞	0.712	0.719	2½	$\frac{3}{16}$	$\frac{3}{32}$	⅝	11	1⅛
1	0.812	0.821	2⅞	¼	⅛	¾	10	$1\frac{5}{16}$
1⅛	0.914	0.922	3¼	¼	⅛	¾	10	$1\frac{5}{16}$
1¼	1.016	1.031	3½	$\frac{5}{16}$	$\frac{5}{32}$	⅞	9	1½
1⅜	1.117	1.133	3⅞	⅜	$\frac{3}{16}$	1	8	1¾
1½	1.219	1.234	4¼	⅜	$\frac{3}{16}$	1⅛	7	2
1⅝	1.320	1.336	4⅝	$\frac{7}{16}$	$\frac{7}{32}$	1¼	7	$2\frac{3}{16}$
1¾	1.422	1.438	5	$\frac{7}{16}$	$\frac{7}{32}$	1¼	7	$2\frac{3}{16}$
1⅞	1.523	1.540	5⅜	½	¼	1½	6	2⅝
2	1.625	1.641	5¾	½	¼	1½	6	2⅝
2¼	1.828	1.845	6½	$\frac{9}{16}$	$\frac{9}{32}$	1¾	5	$3\frac{1}{16}$
2½	2.031	2.047	7¼	⅝	$\frac{5}{16}$	1¾	5	$3\frac{1}{16}$
2¾	2.234	2.258	7⅞	$\frac{11}{16}$	$\frac{11}{32}$	2	4½	3½
3	2.438	2.461	8⅝	¾	⅜	2¼	4½	$3\frac{15}{16}$
3¼	2.438	2.469	9⅜	⅞	$\frac{7}{16}$	2½	4	4⅜
3½	2.625	2.656	10⅛	⅞	$\frac{7}{16}$	2½	4	4⅜
3¾	2.812	2.844	10⅞	$\frac{15}{16}$	$\frac{15}{32}$	2¾	4	$4\frac{13}{16}$
4	3.000	3.031	11⅝	1	½	3	3½	5¼

Important.—In tapering shafts and boring propellers it is necessary to work accurately to the diameter at the small end of the taper, and it should be noted that the diameter of the small end of the hole in the hub of the propeller should be smaller than the diameter of the shaft at the small end of the taper.

COLUMBIAN MOTORSHIP PROPELLERS

Efficiency.—The refinements of the designs of Columbian Motorboat Propellers, their accuracy of workmanship and high quality throughout have in a few years placed them far in the lead of other makes. We are now applying this experience in propeller manufacture to a standardized line of Motorship Propellers, and while these heavier propellers cannot be designed with the same degree of refinement as the smaller ones, the principles are the same and increased efficiency in the larger class means much more in actual dollars saved than in the smaller.

If through a reduction of the resistance to rotation the same size (diameter, pitch and blade area) propeller can be turned the same number of revolutions per minute with less power, fuel is saved. If the same size propeller can be turned a greater number of revolutions with the same power, speed is increased and running time reduced. If with the same power a larger propeller (either diameter, pitch or blade area as conditions may necessitate) can be turned the same number of revolutions, either speed or driving power may be increased, whichever is required by the service in which the ship is engaged.

If in addition to this, the efficiency of the propeller is increased, that is, driving power per revolution, a large additional saving results.

The savings accomplished in the small class of propellers we are now obtaining in the larger, and experience thus far convinces us that these problems have not heretofore received the careful study they merit.

The wonderful achievements in other lines of effort by scientific application to the problems involved can be fully duplicated in the line of large propellers, and the opportunities for increased efficiency are now offered to the owners and designers of motorships.

Standardization.—The Columbian line of Motorboat propellers is so complete that every possible requirement of any Naval Architect in designing a special propeller for any individual motorboat can be filled by a propeller selected from one of our stock patterns.

Eventually we aim to make our line of Motorship Propellers complete enough to meet any requirement in that line also. Our line now comprises the several different styles illustrated in the following pages, and the wide range of diameters, pitches and blade areas will go far toward the accomplishment of our aim.

Suggestions.—Our aim has always been to follow the ship designer but to lead the propeller manufacturers of the world in producing the standards that the industry requires. It is our desire to fully meet the demands of designers both in general and in details of manufacture. To this end we at all times solicit your ideas and suggestions.

Style M. H. Fig. 120
Columbian Hercules Propeller

Made in even diameters, 52 to 96 inches. Any ordinary pitch. Blades areas are shown on page 32. Hub dimensions on page 21. Greatest width of blade one-third of the diameter. Prices upon application.

Columbian Motorship Propellers are made in all styles in even diameters, 52 to 96 inches, two, three or four blades, right or left hand, and can be furnished with any ordinary pitch from a pitch ratio of .6 to 1.5. Propellers with special pitches made to order.

Propellers with larger hubs or other slight alterations can be furnished at moderate additional charge.

Style M. I. Fig. 125
Columbian Imperial Propeller

Made in even diameters, 52 to 96 inches. Any ordinary pitch. Blade areas are shown on page 32. Hub dimensions on page 21. Greatest width of blade one-third of the diameter. Prices upon application.

Columbian Motorship Propellers are true screw, accurate to pitch, balanced to weight, polished smooth, but not buffed. The edges are smooth and true; workmanship of "Columbian Quality." They are made of Columbian Manganese Bronze, and designed for greatest stream line efficiency—the least resistance to rotation.

Style M. E. Fig. 130
Columbian Eagle Propeller

Made in even diameters from 52 inches to 96 inches. Any ordinary pitch. Blade areas are shown on page 32. Hub dimensions on page 21. Greatest width of blade one-quarter of the diameter. Prices upon application.

Columbian Motorship Propellers will be furnished on special order not balanced or polished to those desiring to purchase at lowest prices. The castings are smooth, edges filed, and they will be "commercially balanced"—balanced better probably than the ordinary propeller casting.

COLUMBIAN MOTORSHIP PROPELLERS

Approximate Blade Areas—Square Inches

Diameter Inches	2-Blade Propellers			3-Blade Propellers			4-Blade Propellers		
	Style M-H	Style M-I	Style M-E	Style M-H	Style M-I	Style M-E	Style M-H	Style M-I	Style M-E
52	646	656	468	969	984	702	1292	1312	936
54	694	708	496	1041	1062	744	1388	1416	992
56	734	758	530	1101	1137	795	1468	1516	1060
58	784	814	568	1176	1221	852	1568	1628	1136
60	834	866	608	1251	1299	912	1668	1732	1216
62	886	926	646	1329	1389	969	1772	1852	1292
64	940	988	696	1410	1482	1044	1880	1976	1392
66	996	1050	744	1494	1575	1116	1992	2100	1488
68	1058	1116	800	1587	1674	1200	2116	2232	1600
70	1124	1184	856	1686	1776	1284	2248	2368	1712
72	1196	1252	914	1794	1878	1371	2392	2504	1828
74	1268	1320	970	1902	1980	1455	2536	2640	1940
76	1340	1388	1028	2010	2082	1542	2680	2776	2056
78	1416	1458	1084	2124	2187	1626	2832	2916	2168
80	1492	1526	1142	2238	2289	1713	2984	3052	2284
82	1566	1596	1196	2349	2394	1794	3132	3192	2392
84	1648	1670	1262	2472	2505	1893	3296	3340	2524
86	1728	1748	1326	2592	2622	1989	3456	3496	2652
88	1810	1828	1382	2715	2742	2073	3620	3656	2764
90	1896	1916	1456	2844	2874	2184	3792	3832	2912
92	1984	1994	1524	2976	2991	2286	3968	3988	3048
94	2076	2076	1596	3114	3114	2394	4152	4152	3192
96	2174	2166	1664	3261	3249	2496	4348	4332	3328

SPECIAL PROPELLERS

It is our desire to co-operate with naval architects and designers in working out any special propeller problems they may encounter. Our experience in propeller design, and our large fund of information covering the selection of the proper propeller for a very large variety of motor boats and vessels, may be of value. After the design is completed, our facilities for making propeller patterns with the greatest accuracy place us in an exceptionally favorable position to render the best possible service in executing that class of work.

In this connection it should be realized that our pattern makers are working almost constantly on propeller patterns. A glance at the large number of propellers of different styles, diameters and pitches listed in this catalog will make it apparent that our propeller pattern making facilities and experience are exceptional.

There are many elements of propeller design which are not at all understood by the ordinary pattern maker, and the amateur attempting to make a propeller pattern which will produce a propeller embodying the greatest efficiency, will find much to learn before he can accomplish results which will compare favorably in actual speed trials with a propeller manufactured from the patterns of an expert propeller pattern maker.

When the pattern reaches the foundry many more details are encountered which must be closely watched in order to obtain a casting as accurate as the pattern. Manganese Bronze, which is the metal usually specified for propellers, plays many tricks in shrinkages which can easily throw a propeller out of pitch unless the methods of counteracting them are understood.

Our efficiency in making accurate castings is best attested by an order for one hundred and twenty propellers, weighing about two thousand pounds each, for United States Patrol Boats, each blade being thirty-six inches wide; the order being taken on our guarantee that the blades would not be more than one-quarter of an inch out of true across the thirty-six inch face. The order was filled without a single rejection.

Not every foundry can make a smooth manganese bronze casting, which is an essential to economical propeller manufacture, and the polishing and balancing require a skilled and carefully trained organization.

All of these essentials are assured by the facilities and efficiency of our organization.

Built Up Propellers.—Where propellers are designed with separate blades bolted to the hub they are usually of large size; therefore the possibilities for vibration and inefficiency are more important because more costly than on the smaller propellers. It is even more essential, therefore, that the individual blades are accurate and properly machined than on the smaller propellers.

Built-up Propellers

We make a specialty also of castings of blades and hubs of built-up propellers to customers' specifications. The smoothness and accuracy of Columbian Castings has made our reputation for this class of work.

PROPELLERS IN A NUTSHELL

The principle of a propeller is that of a screw, which advances along its axis a certain definite distance for every complete revolution it makes in its nut. The water is the nut in the case of the propeller, and the pitch is the distance it would advance in each revolution if the water were solid and there were no slip. A propeller 20 x 30 inches —that is, 20 inches in diameter with a pitch of 30 inches—would theoretically travel with the boat 30 inches with each revolution. At 500 revolutions per minute it would travel in one minute $30 \times 500 = 15{,}000$ inches, or 1,250 feet, and in one hour 75,000 feet, or about 14.2 miles. This is called the theoretical speed of the propeller.

Water, however, being a liquid, yields under the impulse of the propeller and actually moves back in relation to the water which surrounds it. Owing to this yielding and to several other causes, the speed of the boat is considerably less than the theoretical speed of the propeller. The difference is called the "apparent slip," or "slip." The slip is found by subtracting the actual speed of the boat from the theoretical speed of the propeller as found above. Dividing the slip by the theoretical speed of the propeller gives the percentage of slip. (See table page 41.) Best results are obtained on motorboats with a slip of from 15 to 25 per cent.

Pitch ratio is the ratio of the pitch of the propeller to its diameter. In the 20 x 30-inch wheel the pitch ratio is 1.5, or one point five, as it is commonly called. A ratio of 1.25 is known as one point two five, etc. In modern motorboat practice, a pitch ratio of from .8 to 1.5 is considered good. On high-speed boats, owing to their shallow draught and the fact that they slide through the water with the least possible resistance, good results are often obtained with a pitch ratio of 1.8 or even as high as 2.0, but for cruisers or ordinary runabouts a pitch ratio higher than 1.5 does not usually show proper efficiency unless the lines are very fine and the boat of light construction.

The efficiency of a propeller depends upon its ability to force the water straight astern. The tendency to rotate the water, or throw it off the ends of the blades, diminishes its efficiency, wastes power and increases the slip.

Ordinarily speaking, the coarser the lines of the boat and the heavier its construction, the greater the slip.

For a heavy-working boat with bluff lines, best results are obtained with a propeller with a low pitch ratio. The resistance of the water in front of such a boat is so great that a propeller with a high pitch would tend merely to rotate the water instead of forcing it astern.

On the other hand, a long, narrow racing boat with fine lines passes through the water so easily that with a high pitch propeller the forward push is sufficient to move it, and the percentage of slip is normal.

If the propeller shaft is inclined too much from the horizontal, the slip is increased, as the propeller forces the water downwardly and not directly astern. An inclination of 5 degrees from the horizontal is considered good practice. It should not be over 10 degrees.

In order to get the greatest efficiency from a propeller, it is necessary that the water shall have free access to the propeller from the front and free passage from it astern. Perhaps the greatest trouble-maker in this connection is the "deadwood." The "deadwood," or "skeg," serves two purposes: it strengthens the bottom of the boat and protects the propeller. At the same time a thick deadwood seriously obstructs the supply of water to the propeller and reduces the speed of the boat. Take the case of a 16-inch two-blade propeller behind a deadwood 4 inches thick. Whenever the propeller comes to a vertical position, the supply of water is almost cut off. This not only seriously interferes with the speed, but causes vibration as well. A slip of 35 or 40 per cent is not uncommon in a case of this kind.

It is almost an invariable rule that a three-blade wheel should be used with a thick deadwood, for two blades are then always working. The wheel should be as large in diameter as possible, and if the power is not sufficient, the blades should be fairly narrow and the pitch reduced until the normal speed of the engine is obtained.

On a light boat the best way to overcome the difficulty is to remove the deadwood. A bronze strut or hanger will offer less resistance to the water and allow a proper flow of water to the propeller. It is very strong, and can be made to thoroughly protect the propeller. The speed of one boat was increased just one mile per hour by such a change.

Vibration usually laid to the propeller is likely to be caused by something else. There are only three possible defects in the propeller itself, which would cause vibration: first, not being properly balanced; second, not being true pitch, that is, the pitch not being the same in all of the blades; third, not being bored centrally. Vibration may occur if the propeller is too close to the bottom of the boat or too close to the rudder, if the rudder is not properly hung, if the propeller is too large for the engine, if the engine is unbalanced or the universal joint off center.

When the propeller is in action, there passes through it a column of water of circular cross section, the diameter being slightly greater

Five-Masted Schooner, 250 feet over all length, equipped with two 100-horsepower Type C-O Fairbanks Morse Oil Engines and 52-inch Columbian Imperial Motorship Propellers.

than the diameter of the propeller, and the length of the column being equal to the theoretical speed of the propeller. With the 20 x 30-inch propeller cited above at 500 r. p. m., there passes in one hour a circular column of water somewhat more than 20 inches in diameter and about 14 miles long. If the propeller is well designed and the water has free passage to and from it, the actual length of the column which passes through should not fall far short of the theoretical length, especially if it is a three-blade propeller and the number of revolutions is not so great as to cause it to churn. In other words, if the propeller is correctly designed, there will be very little loss in the amount of water which passes it. The slip will be due mostly to the backward motion of the column in relation to the water which surrounds it, and that is due to the resistance of the hull to forward motion.

This illustrates the necessity of using a propeller which is correctly designed. If the wheel throws the water off the ends of the blades, as many do, or if it churns the water, power will be lost. The water must be forced directly astern to obtain the greatest efficiency. The disturbance in the wake of a Columbian Propeller is very narrow, showing that the water goes directly aft, and therefore the greatest possible amount of propelling power is obtained.

Columbian Propellers are all true screw except the weedless propeller. A true screw propeller is one in which the pitch is the same from

the end of the blade to the hub. Obviously the pitch ratio near the hub is much greater than at the end, for the diameter at that point is smaller, while the pitch is the same. The face of the blade near the end is therefore more nearly at right angles to the shaft, while near the hub it is more nearly in line with the shaft. From the fact that the surface of the blade near the hub is so nearly in line with the shaft, it is maintained by some that this part of the propeller merely churns or rotates the water and does not exert propelling power. If the propeller were not advancing, this might be true, but it must be remembered that a column of water nearly equal in length to the pitch of the propeller is passing at every revolution, so while the water does rotate some on account of friction, it passes through so quickly that there is little chance for churning.

"Churning," when it occurs, may be due to several causes. A propeller with three wide blades revolved at high speed is likely to churn, as the water has less chance to pass between the blades. A two-blade propeller is often better in this respect at high speed, and this accounts for many cases where the speed is increased by substituting a two-blade wheel for a three-blade. Churning may also occur where a heavy, wide boat is equipped with a propeller with a high pitch ratio, or where the pitch or size of the wheel is so small that the engine races.

We have been asked many times to furnish a formula for determining the proper propeller for various boats, but there are so many variables affecting the performance of the many different designs of hulls that it has been impossible up to the present time to develop a formula that is practical, especially for the small class of boats.

In selecting a propeller the first consideration is the power of the engine, and it is essential that the power and the number of revolutions to be turned per minute be known accurately. With this information the approximate size of propeller may be determined quite accurately from the Propeller Table in the following pages.

Having determined the approximate diameter and pitch the engine will turn, the lines of the boat must next be considered in the light of the information contained in the preceding pages, and the proper pitch ratio decided upon. If the pitch ratio selected is the same as the propeller shown in the table, that propeller should be used. If the pitch ratio is lower, the diameter will be greater and the pitch lower, and vice versa, but care must be taken to see that the average of the diameter and pitch about equal that shown in the table, otherwise the engine will either be overloaded or turn too fast.

The determination of the proper blade area is difficult for the amateur, as there are no hard and fast rules to govern it. In general a heavy or hard driving boat should have a propeller with a large blade area, especially if the engine turns less than 600 r. p. m. Over 800 r. p. m. a wide blade is likely to churn. In general also the lighter the boat, and the faster the engine turns, the smaller should be the blade area.

A hydroplane is usually a hard-driving boat until it starts to plane. It is therefore usually necessary to use a wide-blade propeller

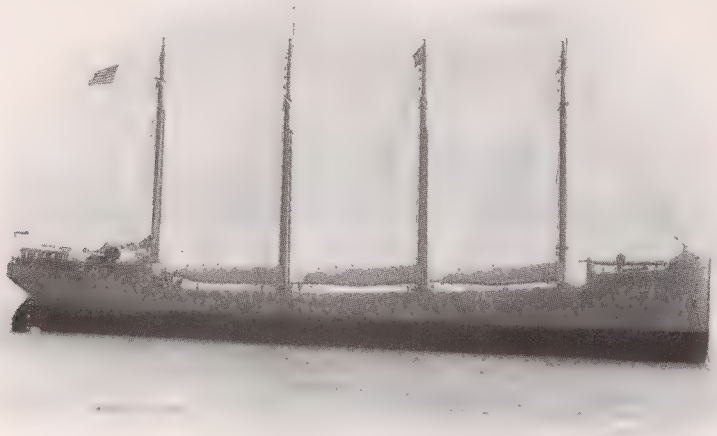
like the Columbian Ailsa Craig to force it to plane. While it planes it drives easily and the propeller usually turns at extreme speed. If, therefore, a narrow-blade propeller could be substituted after it starts to plane, better speed would undoubtedly result.

When the stern of a boat "squats" or "sucks down" it is often possible to overcome the trouble by installing a propeller with narrow blades and low pitch.

Squatting, however, is usually due to the fact that the stern of the boat is too narrow to offer a sufficient amount of buoyancy when the boat is in motion. It is almost impossible to overcome it without rebuilding the stern. The use of "Squat Boards" has been moderately successful in some cases.

While the foregoing covers the main points to consider in selecting the proper propeller, a great deal of experience and practice are necessary to produce maximum results on any boat, and it is our earnest desire that every Columbian Propeller shall produce the greatest efficiency. We therefore not only offer our services without charge, but we urge you to apply to your dealer or write our New York Office for a copy of the Columbian "Propeller Questionnaire" and to return it to us accurately filled in, in order that we may suggest the size and style of propeller that will be best for your boat.

The ideal propeller should be made of material strong enough so the blades can be made very thin and sharp without sacrificing strength. The thinner and sharper the blades, the better the speed results. Columbian Manganese Bronze is of such strength and toughness that the blades, although thin and sharp, are yet nearly twice as strong as those of ordinary propellers. Columbian Propellers are superior in every detail, and when properly selected for the boat, produce results that cannot be equalled by any other make.



Motorship "Starlite" owned by the Standard Oil Co., New York City, 260 feet long, driven by 320-horsepower Bolinders oil engine, turning a special 4-blade propeller 7½ feet diameter, designed by the American Screw Propeller Co., cast of Columbian Manganese Bronze.

EXPLANATION OF TABLE OF SPEEDS

This table shows the speed in miles per hour (m. p. h.) of boats with propellers of ordinary pitches at common engine speeds. It also shows the percentages of slip and the theoretical speed of the propeller.

Four different speeds are shown for each pitch at each engine speed. These four speeds correspond to four different percentages of slip, as shown in the "percentage of slip" column. The percentage marked "None" indicates no slip, and is the theoretical speed of the propeller. Thus the 20 x 30-inch propeller mentioned on page 35 at 500 r. p. m. shows in the 30-inch pitch column at 500 r. p. m., 14.2 miles per hour as the theoretical speed. If this boat actually makes 11.36 m. p. h. at 500 r. p. m. you can see at a glance in the "per cent of slip" column that the propeller shows 20 per cent slip.

These theoretical speeds may be used in figuring speeds and percentages not shown in the table. To find the percentage of slip for a boat traveling 10 m. p. h., with an engine speed of 500 r. p. m. and a propeller with 28-inch pitch. Follow the column for 28-inch pitch down to the line of 500 r. p. m. Ten m. p. h. is not shown, but the percentage of slip for 10.61 miles is 20 per cent, and the percentage for 9.28 miles is 30 per cent, therefore the percentage for 10 miles would be about 23 per cent.

For a new boat, knowing the engine speed and the desired speed in miles per hour, to find the proper pitch of propeller first estimate the probable percentage of slip according to the type of boat, then for the known engine speed and percentage follow the line to the right to the figure nearest to the desired speed. Follow that column up and the necessary pitch will be found at the top of the column.

Knowing the pitch, engine speed and horsepower, from the Table of Propellers, the proper diameter may be computed.

Assume that your boat makes 9½ m. p. h. using a propeller 22-inch diameter, with 24-inch pitch (22 x 24), turning 600 r. p. m. This shows 30 per cent slip and you know your engine is overloaded and think you can increase your speed by using a propeller of the same diameter with less pitch turning 800 r. p. m. What pitch should you select? This can be roughly estimated as follows:

The theoretical speed of 24-inch pitch at 600 r. p. m. is 13.64 miles. In other words, your engine has enough power to displace in one hour a column of water 22-inch diameter, 13.64 miles long. At 800 r. p. m. you find the same theoretical speed under 18-inch pitch, so it is reasonably safe to assume that your engine will turn a 22 x 18 propeller 800 r. p. m., and as this pitch ratio is much lower, you can reasonably figure 25 per cent slip, which shows a speed of about 10¼ m. p. h.

TABLE OF SPEEDS

(For Explanation See Page 40)

This Table Shows Speed of Boat in Miles Per Hour

R.P.M.	Per Cent. of Slip	PITCH OF PROPELLER IN INCHES															
		14″	16″	18″	20″	22″	24″	26″	28″	30″	32″	33″	34″	36″	38″	40″	42″
250	None				4.74	5.21	5.68	6.16	6.63	7.10	7.58	7.81	8.05	8.52	8.99	9.47	9.94
	10%				4.26	4.69	5.11	5.54	5.97	6.39	6.82	7.03	7.25	7.68	8.09	8.52	8.95
	20%				3.79	4.17	4.54	4.93	5.30	5.68	6.06	6.25	6.44	6.82	7.21	7.58	7.96
	30%				3.32	3.65	3.98	4.31	4.64	4.97	5.30	5.47	5.63	5.96	6.32	6.63	6.98
300	None			5.11	5.68	6.25	6.82	7.39	7.95	8.52	9.09	9.38	9.66	10.23	10.80	11.36	11.93
	10%			4.60	5.11	5.63	6.14	6.65	7.16	7.68	8.18	8.44	8.69	9.20	9.72	10.22	10.74
	20%			4.09	4.54	5.00	5.46	5.91	6.37	6.82	7.27	7.50	7.73	8.18	8.64	9.09	9.55
	30%			3.58	3.98	4.37	4.77	5.17	5.57	5.96	6.36	6.56	6.76	7.16	7.56	7.95	8.36
350	None		5.30	5.96	6.63	7.29	7.96	8.62	9.28	9.94	10.61	10.94	11.27	11.93	12.58	13.26	13.92
	10%		4.77	5.37	5.97	6.56	7.16	7.76	8.35	8.95	9.55	9.85	10.14	10.74	11.32	11.93	12.53
	20%		4.24	4.77	5.30	5.84	6.37	6.90	7.42	7.95	8.49	8.75	9.02	9.54	10.06	10.61	11.14
	30%		3.71	4.18	4.64	5.11	5.57	6.03	6.50	6.96	7.43	7.66	7.89	8.35	8.80	9.28	9.75
400	None	5.30	6.06	6.82	7.58	8.33	9.08	9.85	10.61	11.36	12.12	12.50	12.88	13.63	14.38	15.15	15.90
	10%	4.77	5.45	6.14	6.82	7.50	8.18	8.87	9.55	10.22	10.91	11.25	11.59	12.27	12.94	13.63	14.31
	20%	4.24	4.85	5.45	6.06	6.66	7.27	7.88	8.49	9.09	9.70	10.00	10.30	10.90	11.50	12.12	12.72
	30%	3.71	4.24	4.77	5.30	5.83	6.36	6.89	7.43	7.95	8.48	8.75	9.02	9.54	10.06	10.61	11.13
450	None	5.97	6.82	7.67	8.52	9.38	10.23	11.08	11.93	12.78	13.64	14.06	14.49	15.34	16.19	17.05	17.90
	10%	5.37	6.14	6.90	7.68	8.44	9.20	9.97	10.74	11.50	12.27	12.65	13.04	13.81	14.57	15.35	16.11
	20%	4.78	5.46	6.14	6.82	7.50	8.18	8.86	9.54	10 23	10.91	11.25	11.59	12.27	12.95	13.64	14.32
	30%	4.18	4.77	5.37	5.96	6.56	7.16	7.76	8 35	8 95	9.54	9.84	10.14	10.74	11.33	11.94	12.89
500	None	6.63	7.58	8.52	9.47	10.42	11.36	12 31	13.26	14 20	15.15	15.63	16.10	17.05	18.01	18.94	19.90
	10%	5.97	6.82	7.68	8.52	9.38	10.22	11.08	11.93	12.78	13.63	14.07	14.49	15.35	16.21	17.05	17.91
	20%	5.30	6.06	6.82	7.58	8.33	9.09	9.85	10.61	11.36	12.12	12.50	12.88	13.65	14.41	15.15	15.92
	30%	4.64	5.31	5.96	6.63	7.29	7.95	8.62	9.28	9.94	10.61	10.94	11.27	11.93	12.61	13.26	13.93
550	None	7.29	8.33	9.38	10.42	11.46	12.50	13 54	14.58	15.63	16.67	17.19	17.71	18.75	19.77	20.83	21.87
	10%	6.56	7.50	8.44	9.38	10.31	11.25	12.19	13.12	14 07	15.00	15.47	15.94	16.87	17.79	18.75	19.68
	20%	5.84	6.66	7.50	8.33	9.17	10.00	10.83	11.66	12.50	13.34	13.75	14.17	15.00	15.81	16.66	17.49
	30%	5.11	5.83	6.56	7.29	8.02	8.75	9.48	10.21	10.94	11.67	12.03	12.40	13.13	13.83	14.58	15.30
600	None	7.96	9.09	10.23	11.36	12.50	13.64	14.77	15.91	17.05	18.18	18.75	19.32	20.46	21.65	22.73	23.90
	10%	7.16	8.18	9.20	10.22	11.25	12.27	13.29	14.32	15.34	16.36	16.87	17.39	18.41	19.49	20.46	21.51
	20%	6.37	7.27	8.18	9.09	10.00	10.91	11.82	12.73	13.64	14.54	15.00	15.46	16.37	12.31	18.18	19.12
	30%	5.57	6.36	7.16	7.95	8.75	9.54	10.34	11.14	11.93	12.73	13.13	13.52	14.32	15.14	15.91	16.73
650	None	8.62	9.85	11.08	12.31	13.54	14.77	16.00	17.24	18.47	19.70	20.31	20.93	22.16	23.38	24.62	25.83
	10%	7.76	8.87	9.97	11.08	12.19	13.29	14.40	15.52	16.62	17.73	18.28	18.84	19.94	21.04	22.16	23.25
	20%	6.90	7.88	8.86	9.85	10.83	11.82	12.80	13.79	14.78	15.76	16.25	16.74	17.73	18.70	19.70	20.67
	30%	6.03	6.89	7.76	8.62	9.48	10.34	11.20	12.07	12.93	13.79	14.22	14.65	15.51	16.36	17.23	18.09
700	None	9.28	10.61	11.93	13.26	14.58	15.91	17.24	18.56	19.89	21.22	21.87	22.54	23.86	25.17	26.52	27.81
	10%	8.35	9.55	10.74	11.93	13.12	14.32	15.52	16.70	17.90	19.10	19.68	20.29	21.47	22.65	23.87	25.03
	20%	7.42	8.49	9.54	10.61	11.66	12.73	13.79	14.85	15.91	16.98	17.50	18.03	19.09	20.13	21.22	22.25
	30%	6.50	7.43	8.35	9.28	10.21	11.14	12.07	12.99	13.92	14.85	15.31	15.78	16.70	17.61	18.57	19.47
750	None	9.94	11.36	12.78	14.20	15.63	17.05	18.47	19.89	21.31	22.73	23.44	24.15	25.57	27.00	28.41	29.80
	10%	8.95	10.22	11.50	12.78	14.07	15.34	16.62	17.90	19.18	20.46	21.10	21.73	23.01	24.30	25.57	26.82
	20%	7.95	9.09	10.23	11.36	12.50	13.64	14.78	15.91	17.05	18.18	18.75	19.32	20.46	21.60	22.73	23.84
	30%	6.96	7.95	8.95	9.94	10.94	11.93	12.93	13.92	14.92	15.91	16.41	16.91	17.90	18.90	19.89	19.86
800	None	10.61	12.12	13.64	15.15	16.67	18.18	19.70	21.21	22.73	24.24	25.00	25.76	27.27	28.81	30.30	31.81
	10%	9.55	10.91	12.27	13.63	15.00	16.36	17.73	19.09	20.46	21.82	22.50	23.18	24.54	25.93	27.27	28.63
	20%	8.49	9.70	10.91	12.12	13.34	14.54	15.76	16.97	18.18	19.39	20.00	20.61	21.82	23.05	24.24	25.45
	30%	7.43	8.48	9.54	10.61	11.67	12.73	13.79	14.85	15.91	16.97	17.50	18.03	19.09	20.17	21.21	22.27
900	None	11.93	13.64	15.34	17.05	18.75	20.45	22.16	23.86	25.57	27.27	28.13	28.98	30.68	32.40	34.09	35.80
	10%	10.74	12.28	13.80	15.34	16.87	18.41	19.94	21.47	23.01	24.54	25.32	26.08	27.61	29.16	30.68	32.22
	20%	9.54	10.91	12.27	13.64	15.00	16.37	17.73	19.09	20.46	21.82	22.50	23.19	24.54	25.92	27.27	28.64
	30%	8.35	9.55	10.74	11.93	13.13	14.32	15.51	16.70	17.90	19.09	19.69	20.29	21.48	22.68	23.86	25.06
1000	None	13.26	15.15	17.05	18.94	20.83	22.73	24.62	26.52	28.41	30.30	31.25	32.20	34.09	36.00	37.88	39.85
	10%	11.93	13.63	15.34	17.05	18.75	20.46	22.16	23.87	25.57	27.27	28.13	28.98	30.68	32.40	34.09	35.86
	20%	10.61	12.12	13.64	15.15	16.66	18.18	19.70	21.22	22.73	24.24	25.00	25.76	27.27	28.80	30.30	31.87
	30%	9.28	10.61	11.93	13.26	14.58	15.91	17.23	18.57	19.89	21.21	21.87	22.54	23.86	25.20	26.52	27.88

IS YOUR PROPELLER RIGHT?

Are you sure you have the right propeller for the best results on your boat? Figure the slippage of your propeller by this table. If it is high we can undoubtedly increase your speed. Have you a Columbian Propeller Questionnaire? It shows how to time your boat over a measured course, and what information about your boat we require to recommend the most suitable propeller. Write for one and let us advise you.

TABLE OF SPEEDS

(For Explanation See Page 40)

This Table Shows Speed of Boat in Miles Per Hour

R.P.M.	Per Cent. of Slip	PITCH OF PROPELLER IN INCHES 44″	46″	48″	50″	52″	54″	56″	58″	60″	62″	64″	66″	68″	70″	72″	74″
75	None	3.1	3.3	3.4	3.6	3.7	3.8	4.0	4.1	4.2	4.4	4.5	4.7	4.8	5.0	5.1	5.2
	10%	2.8	3.0	3.1	3.2	3.3	3.4	3.6	3.7	3.8	3.9	4.0	4.2	4.3	4.5	4.6	4.7
	20%	2.5	2.6	2.7	2.9	2.9	3.0	3.2	3.3	3.4	3.5	3.6	3.7	3.8	4.0	4.1	4.2
	30%	2.2	2.3	2.4	2.5	2.5	2.6	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7
100	None	4.2	4.4	4.5	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.2	6.4	6.6	6.8	7.0
	10%	3.8	4.0	4.1	4.2	4.4	4.6	4.8	4.9	5.1	5.3	5.5	5.6	5.8	5.9	6.1	6.3
	20%	3.4	3.5	3.6	3.8	3.9	4.1	4.3	4.4	4.5	4.7	4.9	5.0	5.2	5.3	5.4	5.6
	30%	2.9	3.1	3.2	3.3	3.4	3.6	3.7	3.8	3.9	4.1	4.3	4.4	4.5	4.6	4.7	4.9
125	None	5.2	5.4	5.7	5.9	6.2	6.4	6.6	6.8	7.1	7.4	7.6	7.8	8.0	8.3	8.5	8.8
	10%	4.7	4.9	5.1	5.3	5.6	5.8	5.9	6.1	6.4	6.7	6.8	7.0	7.2	7.5	7.7	7.9
	20%	4.2	4.3	4.6	4.7	5.0	5.2	5.3	5.4	5.7	6.0	6.1	6.2	6.4	6.7	6.9	7.1
	30%	3.7	3.8	4.0	4.1	4.4	4.5	4.6	4.8	5.0	5.2	5.3	5.4	5.6	5.9	6.1	6.3
150	None	6.2	6.5	6.8	7.1	7.4	7.6	7.9	8.2	8.5	8.8	9.1	9.4	9.6	9.9	10.2	10.5
	10%	5.6	5.9	6.1	6.4	6.7	6.8	7.1	7.4	7.6	8.0	8.2	8.5	8.6	8.9	9.2	9.5
	20%	5.0	5.2	5.4	5.7	6.0	6.1	6.3	6.6	6.7	7.2	7.3	7.6	7.7	7.9	8.2	8.5
	30%	4.4	4.6	4.8	5.0	5.3	5.4	5.5	5.8	6.0	6.2	6.4	6.7	6.8	6.9	7.2	7.5
175	None	7.3	7.6	8.0	8.3	8.6	8.9	9.2	9.6	10.0	10.3	10.6	11.0	11.3	11.6	12.0	12.3
	10%	6.6	6.8	7.2	7.5	7.7	8.0	8.3	8.6	9.0	9.3	9.5	9.9	10.2	10.4	10.8	11.1
	20%	5.8	6.1	6.4	6.6	6.8	7.1	7.4	7.6	8.0	8.3	8.4	8.8	9.1	9.2	9.6	9.9
	30%	5.1	5.3	5.6	5.8	5.9	6.2	6.5	6.6	7.0	7.3	7.5	7.7	8.0	8.2	8.4	8.7
200	None	8.3	8.7	9.9	9.5	9.8	10.2	10.6	11.0	11.4	11.8	12.2	12.6	12.9	13.3	13.7	14.1
	10%	7.5	7.8	8.2	8.5	8.8	9.2	9.5	9.9	10.3	10.6	11.0	11.3	11.6	12.0	12.3	12.7
	20%	6.7	7.0	7.3	7.6	7.8	8.2	8.4	8.8	9.2	9.4	9.8	10.0	10.3	10.7	10.9	11.3
	30%	5.8	6.1	6.4	6.6	6.8	7.2	7.3	7.7	8.1	8.2	8.6	8.7	9.0	9.4	9.5	9.9
250	None	10.4	10.9	11.4	11.8	12.3	12.8	13.3	13.7	14.2	14.7	15.1	15.6	16.1	16.6	17.0	17.6
	10%	9.4	9.8	10.2	10.7	11.1	11.5	11.9	12.4	12.8	13.2	13.6	14.1	14.5	14.9	15.3	15.8
	20%	8.3	8.7	9.1	9.5	9.8	10.2	10.6	11.0	11.4	11.7	12.1	12.5	12.9	13.2	13.6	14.0
	30%	7.3	7.6	8.0	8.3	8.6	8.9	9.3	9.6	9.9	10.3	10.6	10.9	11.3	11.5	11.9	12.2
300	None	12.5	13.1	13.6	14.2	14.7	15.3	15.9	16.5	17.0	17.6	18.2	18.8	19.4	20.0	20.5	21.1
	10%	11.3	11.8	12.3	12.8	13.2	13.8	14.3	14.8	15.3	15.9	16.4	16.9	17.5	18.0	18.5	19.0
	20%	10.0	10.5	10.9	11.4	11.8	12.3	12.7	13.2	13.6	14.1	14.5	15.0	15.6	16.0	16.5	16.9
	30%	8.8	9.2	9.6	10.0	10.3	10.7	11.1	11.5	11.9	12.3	12.7	13.1	13.7	14.0	14.5	14.8
350	None	14.6	15.3	16.0	16.6	17.2	17.9	18.6	19.2	19.9	20.6	21.2	21.9	22.6	23.3	24.0	24.7
	10%	13.1	13.8	14.3	14.9	15.5	16.1	16.7	17.3	17.9	18.5	19.1	19.7	20.3	21.0	21.6	22.2
	20%	11.7	12.2	12.7	13.3	13.7	14.3	14.9	15.4	15.9	16.4	17.0	17.5	18.0	18.7	19.2	19.7
	30%	10.2	10.7	11.1	11.6	12.1	12.5	13.0	13.5	13.9	14.4	14.9	15.3	15.7	16.4	16.8	17.2
400	None	16.7	17.4	18.2	18.9	19.6	20.4	21.2	22.0	22.7	23.5	24.2	25.0	25.8	26.6	27.4	28.1
	10%	15.0	15.7	16.4	17.0	17.7	18.4	19.1	19.8	20.4	21.1	21.8	22.5	23.2	23.9	24.7	25.3
	20%	13.3	14.0	14.6	15.2	15.7	16.4	16.9	17.6	18.2	18.8	19.4	20.0	20.6	21.2	22.0	22.5
	30%	11.7	12.2	12.7	13.3	13.7	14.3	14.8	15.4	15.9	16.4	17.0	17.5	18.0	18.4	19.3	19.7
450	None	18.8	19.6	20.5	21.3	22.1	23.1	23.9	24.7	25.6	26.4	27.3	28.1	28.9	29.8	30.6	31.5
	10%	16.9	17.6	18.4	19.2	19.9	20.7	21.5	22.3	23.0	23.8	24.5	25.3	26.0	26.8	27.5	28.4
	20%	15.0	15.7	16.4	17.1	17.7	18.4	19.1	19.8	20.4	21.2	21.8	22.5	23.1	23.8	24.4	25.3
	30%	13.1	13.7	14.3	14.9	15.5	16.1	16.7	17.3	17.9	18.5	19.1	19.7	20.2	20.8	21.3	22.2
500	None	20.8	21.8	22.7	23.7	24.6	25.6	26.5	27.5	28.4	29.3	30.2	31.2	32.2	33.1	34.1	35.0
	10%	18.7	19.6	20.5	21.3	22.1	23.0	23.9	24.7	25.5	26.4	27.2	28.1	29.0	29.8	30.7	31.5
	20%	16.7	17.4	18.2	19.0	19.7	20.4	21.2	22.0	22.7	23.5	24.2	25.0	25.8	26.5	27.3	28.0
	30%	14.6	15.3	15.9	16.6	17.2	17.8	18.6	19.2	19.9	20.5	21.2	21.8	22.6	23.2	23.9	24.5
550	None	22.9	24.0	25.0	26.1	27.1	28.1	29.2	30.2	31.2	32.3	33.3	34.4	35.3	36.4	37.4	38.5
	10%	20.6	21.6	22.5	23.4	24.4	25.3	26.3	27.2	28.1	29.1	30.0	30.9	31.8	32.8	33.7	34.7
	20%	18.3	19.2	20.0	20.9	21.7	22.5	23.3	24.2	25.0	25.8	26.7	27.5	28.3	29.2	30.0	30.9
	30%	16.1	16.8	17.5	18.2	19.1	19.7	20.4	21.1	21.9	22.6	23.4	24.1	24.8	25.6	26.3	27.1
600	None	25.0	26.1	27.3	28.4	29.5	30.6	31.8	32.9	34.1	35.2	36.4	37.5	38.6	39.7	40.8	42.0
	10%	22.5	23.5	24.5	25.6	26.5	27.5	28.6	29.6	30.7	31.7	32.8	33.7	34.7	35.7	36.7	37.8
	20%	20.0	20.9	21.8	22.7	23.5	24.4	25.4	26.3	27.3	28.2	29.2	29.9	30.8	31.7	32.6	33.6
	30%	17.5	18.3	19.1	19.9	20.5	21.3	22.2	23.0	23.9	24.7	25.6	26.1	26.9	27.7	28.5	29.4
650	None	27.1	28.3	29.6	30.8	32.0	33.2	34.4	35.7	36.9	38.1	39.4	40.6	41.8	43.0	44.2	45.5
	10%	24.4	25.5	26.6	27.7	28.8	29.9	31.0	32.1	33.2	34.3	35.5	36.5	37.6	38.7	39.8	41.0
	20%	21.7	22.7	23.7	24.6	25.6	26.6	27.6	28.5	29.5	30.9	31.6	32.4	33.4	34.4	35.4	36.5
	30%	19.0	19.8	20.7	21.6	22.4	23.3	24.2	24.9	25.8	27.5	27.7	28.3	29.2	30.1	31.0	32.0
700	None	29.2	30.5	31.8	33.2	34.4	35.7	37.0	38.4	39.8	41.0	42.4	43.7	45.0	46.4	47.7	49.0
	10%	26.2	27.4	28.6	29.8	31.0	32.1	33.3	34.6	35.8	36.9	38.2	39.3	40.5	41.8	42.9	44.1
	20%	23.4	24.4	25.5	26.5	27.6	29.5	29.6	30.8	31.8	32.8	34.0	34.9	36.0	37.2	38.1	39.2
	30%	20.4	21.4	22.3	23.2	24.2	25.9	25.9	27.0	27.8	28.7	29.8	30.5	31.5	32.6	33.3	34.3
750	None	31.3	32.7	34.1	35.5	36.9	38.3	39.8	41.2	42.6	44.0	45.4	46.8	48.2	49.7		
	10%	28.1	29.4	30.7	32.0	33.2	34.5	35.8	37.1	38.3	39.6	40.9	42.1	43.4	44.7		
	20%	25.0	26.2	27.3	28.4	29.5	30.7	31.8	33.0	34.0	35.2	36.4	37.4	38.6	39.7		
	30%	21.9	22.9	23.9	24.9	25.8	26.9	27.8	28.9	29.7	30.8	31.9	32.7	33.8	34.7		
800	None	33.3	34.9	36.4	37.9	39.3	40.8	42.4	45.4	46.9	48.4	50.0					
	10%	39.9	31.4	32.7	34.1	35.4	36.7	38.2	40.9	42.2	43.6	45.0					
	20%	26.7	27.9	29.1	30.3	31.5	32.6	34.0	36.4	37.5	38.8	40.0					
	30%	23.3	24.4	25.5	26.5	27.6	28.5	29.8	31.9	32.8	34.0	35.0					

TABLE OF SPEEDS

(For Explanation See Page 40)

This Table Shows Speed of Boat in Miles Per Hour

R.P.M.	Per Cent. of Slip	PITCH OF PROPELLER IN INCHES 76″	78″	80″	82″	84″	86″	88″	90″	92″	94″	96″	98″	100″	102″	104″	106″
75	None	5.4	5.5	5.7	5.8	6.0	6.1	6.3	6.4	6.5	6.7	6.8	7.0	7.2	7.3	7.4	7.6
	10%	4.9	5.0	5.1	5.2	5.4	5.5	5.7	5.8	5.9	6.0	6.1	6.3	6.5	6.5	6.7	6.8
	20%	4.4	4.4	4.5	4.6	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.6	5.7	5.8	5.9	6.0
	30%	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3
100	None	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.7	9.9	10.0
	10%	6.5	6.7	6.8	7.0	7.2	7.4	7.6	7.7	7.9	8.1	8.3	8.5	8.6	8.7	8.9	9.0
	20%	5.8	6.0	6.1	6.2	6.4	6.6	6.8	6.9	7.0	7.2	7.4	7.6	7.7	7.8	7.9	8.0
	30%	5.1	5.2	5.3	5.4	5.6	5.8	5.9	6.0	6.1	6.3	6.5	6.6	6.7	6.8	6.9	7.0
125	None	9.0	9.2	9.5	9.7	10.0	10.2	10.4	10.7	11.0	11.2	11.4	11.7	11.9	12.1	12.3	12.5
	10%	8.1	8.3	8.6	8.7	9.0	9.2	9.4	9.7	9.9	10.1	10.3	10.5	10.7	10.9	11.1	11.3
	20%	7.2	7.4	7.7	7.7	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.3	9.5	9.7	9.9	10.1
	30%	6.4	6.5	6.8	7.0	7.1	7.2	7.4	7.5	7.7	7.9	8.0	8.1	8.3	8.5	8.7	8.8
150	None	10.8	11.0	11.4	11.6	11.9	12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.2	14.5	14.8	15.0
	10%	9.7	9.9	10.3	10.4	10.7	11.0	11.3	11.5	11.8	12.1	12.3	12.6	12.8	13.1	13.3	13.5
	20%	8.6	8.8	9.2	9.3	9.5	9.8	10.1	10.2	10.5	10.8	10.9	11.2	11.4	11.7	11.8	12.0
	30%	7.6	7.7	8.1	8.2	8.3	8.6	8.9	9.0	9.2	9.5	9.6	9.8	10.0	10.3	10.4	10.5
175	None	12.6	13.0	13.4	13.7	14.0	14.4	14.7	15.0	15.4	15.7	16.0	16.4	16.7	16.9	17.3	17.6
	10%	11.3	11.7	12.1	12.3	12.6	13.0	13.2	13.5	13.9	14.1	14.4	14.8	15.0	15.2	15.6	15.8
	20%	10.0	10.4	10.8	10.9	11.2	11.6	11.7	12.0	12.4	12.5	12.8	13.2	13.3	13.5	13.9	14.0
	30%	8.8	9.1	9.5	9.6	9.8	10.2	10.3	10.5	10.9	11.0	11.2	11.6	11.7	11.8	12.2	12.3
200	None	14.5	14.9	15.2	15.6	16.0	16.4	16.8	17.2	17.6	17.8	18.4	18.8	19.2	19.3	19.7	20.0
	10%	13.1	13.4	13.7	14.0	14.4	14.8	15.1	15.5	15.8	16.0	16.6	16.9	17.3	17.4	17.7	18.0
	20%	11.7	11.9	12.2	12.4	12.8	13.2	13.4	13.8	14.0	14.2	14.8	15.0	15.4	15.5	15.7	16.0
	30%	10.3	10.4	10.7	10.8	11.2	11.6	11.7	12.1	12.2	12.4	13.0	13.1	13.5	13.6	13.7	14.0
250	None	18.0	18.6	19.0	19.5	20.0	20.5	21.0	21.4	22.0	22.4	22.8	23.4	23.9	24.1	24.6	25.1
	10%	16.2	16.7	17.1	17.6	18.0	18.5	18.9	19.3	19.8	20.2	20.5	21.1	21.5	21.7	22.1	22.6
	20%	14.4	14.8	15.2	15.7	16.0	16.5	16.8	17.2	17.6	18.0	18.2	18.8	19.1	19.3	19.6	20.1
	30%	12.6	12.9	13.3	13.8	14.0	14.5	14.7	15.1	15.4	15.8	15.9	16.5	16.7	16.9	17.1	17.6
300	None	21.7	22.3	22.9	23.4	24.0	24.6	25.2	25.7	26.3	26.9	27.5	28.0	28.6	28.9	29.5	30.1
	10%	19.5	20.1	20.6	21.1	21.6	22.1	22.7	23.1	23.7	24.2	24.8	25.2	25.7	26.0	26.6	27.1
	20%	17.3	17.9	18.3	18.8	19.2	19.6	20.2	20.5	21.1	21.5	22.1	22.4	22.8	23.1	23.7	24.1
	30%	15.1	15.7	16.0	16.5	16.8	17.1	17.7	17.9	18.5	18.8	19.4	19.6	19.9	20.2	20.8	21.1
350	None	25.3	26.0	26.7	27.4	28.0	28.8	29.4	30.0	30.8	31.4	32.1	32.8	33.4	33.8	34.4	35.1
	10%	22.8	23.4	24.0	24.7	25.2	26.0	26.5	27.0	27.7	28.1	28.9	29.5	30.1	30.4	31.0	31.6
	20%	20.3	20.8	21.3	22.0	22.4	23.2	23.6	24.0	24.6	25.0	25.7	26.2	26.8	27.0	27.6	28.1
	30%	17.8	18.2	18.6	19.3	19.6	20.4	20.7	21.0	21.5	21.9	22.5	22.9	23.5	23.6	24.2	24.6
400	None	28.8	29.6	30.3	31.1	31.8	32.6	33.3	34.0	34.8	35.5	36.3	37.0	37.8	38.6	39.3	40.1
	10%	25.9	26.6	27.3	28.0	28.6	29.3	30.0	30.6	31.3	32.0	32.7	33.3	34.0	34.7	35.4	36.1
	20%	23.0	23.6	24.3	24.9	25.4	26.0	26.7	27.2	27.8	28.5	29.1	29.6	30.2	30.8	31.5	32.1
	30%	20.1	20.6	21.3	21.8	22.2	22.7	23.4	23.8	24.3	25.0	25.5	25.9	26.4	27.0	27.6	28.1
450	None	32.3	33.2	34.0	34.9	35.7	36.6	37.4	38.2	39.1	40.0	40.8	41.7	42.5	43.4	44.2	45.0
	10%	29.1	29.9	30.6	31.4	32.1	32.9	33.7	34.4	35.2	36.0	36.7	37.5	38.3	39.1	39.8	40.5
	20%	25.9	26.6	27.2	27.9	28.5	29.3	30.0	30.6	31.3	32.0	32.6	33.3	34.1	34.8	35.4	36.0
	30%	22.6	23.3	23.8	24.4	24.9	25.7	26.3	26.8	27.4	28.0	28.5	29.1	29.9	30.5	31.0	31.5
500	None	36.0	36.9	37.9	38.8	39.8	40.7	41.7	42.6	43.6	44.5	45.5	46.4	47.4			
	10%	32.4	33.2	34.1	34.9	35.9	36.6	37.5	38.3	39.2	40.1	41.0	41.8	42.7			
	20%	28.8	29.5	30.3	31.0	32.0	32.5	33.3	34.0	34.8	35.7	36.5	37.2	38.0			
	30%	25.2	25.8	26.5	27.1	28.1	28.4	29.1	29.7	30.4	31.3	32.0	32.6	33.3			
550	None	39.8	40.6	41.6	42.7	43.7	44.8	45.8	46.8	47.9	48.9						
	10%	35.9	36.5	37.4	38.4	39.3	40.3	41.2	42.1	43.1	44.0						
	20%	31.8	32.4	33.2	34.1	34.9	35.8	36.6	37.4	38.3	39.1						
	30%	27.8	28.3	29.0	29.8	30.5	31.3	32.0	32.7	33.5	34.2						
600	None	43.2	44.3	45.4	46.6	47.7	48.8	50.0									
	10%	38.9	39.9	40.9	41.9	42.9	43.9	45.0									
	20%	34.6	35.5	36.4	37.2	38.1	39.0	40.0									
	30%	30.3	31.1	31.9	32.5	33.3	34.1	35.0									
650	None	46.7	47.9	49.2	50.4												
	10%	42.0	43.1	44.3	45.4												
	20%	37.3	38.3	39.4	40.4												
	30%	32.6	33.5	34.5	35.4												
700	None	50.4															
	10%	45.4															
	20%	40.4															
	30%	35.4															

TABLE OF SPEEDS

(For Explanation See Page 40)

This Table Shows Speed of Boat in Miles Per Hour

R.P.M.	Per Cent. of Slip	PITCH OF PROPELLER IN INCHES															
		108"	110"	112"	114"	116"	118"	120"	122"	124"	126"	128"	132"	136"	140"	144"	150"
75	None	7.7	7.8	8.0	8.1	8.2	8.4	8.5	8.6	8.8	8.9	9.1	9.4	9.7	10.0	10.2	10.7
	10%	6.9	7.0	7.2	7.3	7.4	7.6	7.7	7.8	7.9	8.0	8.2	8.5	8.7	9.0	9.2	9.6
	20%	6.1	6.2	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.3	7.6	7.7	8.0	8.2	8.5
	30%	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.2	6.4	6.7	6.7	7.0	7.2	7.4
100	None	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	11.9	12.1	12.5	12.8	13.2	13.6	14.2
	10%	9.2	9.4	9.5	9.7	9.9	10.1	10.3	10.4	10.6	10.7	10.9	11.3	11.5	11.9	12.2	12.8
	20%	8.2	8.4	8.5	8.6	8.8	9.0	9.2	9.3	9.4	9.5	9.7	10.1	10.2	10.6	10.8	11.4
	30%	7.2	7.3	7.4	7.5	7.7	7.9	8.0	8.1	8.2	8.3	8.5	8.9	8.9	9.3	9.4	10.0
125	None	12.8	13.0	13.2	13.5	13.7	13.9	14.2	14.4	14.6	14.9	15.2	15.6	16.1	16.6	17.1	17.7
	10%	11.5	11.7	11.9	12.2	12.3	12.5	12.8	13.0	13.1	13.4	13.7	14.0	14.5	14.9	15.4	15.9
	20%	10.2	10.4	10.6	10.9	10.9	11.1	11.4	11.6	11.7	11.9	12.2	12.4	12.9	13.2	13.7	14.1
	30%	8.9	9.1	9.3	9.5	9.6	9.7	10.0	10.1	10.2	10.4	10.7	10.8	11.3	11.5	12.0	12.3
150	None	15.3	15.6	15.9	16.2	16.5	16.8	17.1	17.3	17.6	17.9	18.2	18.8	19.4	19.9	20.5	21.3
	10%	13.8	14.0	14.3	14.6	14.9	15.1	15.4	15.6	15.8	16.1	16.4	16.9	17.5	17.9	18.5	19.2
	20%	12.3	12.4	12.7	13.0	13.3	13.4	13.7	13.9	14.0	14.3	14.6	15.0	15.6	15.9	16.5	17.1
	30%	10.8	10.9	11.1	11.4	11.7	11.8	12.0	12.2	12.3	12.5	12.8	13.1	13.7	13.9	14.5	15.0
175	None	17.9	18.2	18.6	18.9	19.2	19.5	19.8	20.2	20.5	20.8	21.2	21.8	22.5	23.1	23.8	24.8
	10%	16.1	16.4	16.7	17.0	17.3	17.6	17.8	18.2	18.5	18.7	19.1	19.6	20.3	20.8	21.4	22.3
	20%	14.3	14.6	14.8	15.1	15.4	15.7	15.8	16.2	16.5	16.6	17.0	17.4	18.1	18.6	19.0	19.8
	30%	12.5	12.8	12.9	13.2	13.5	13.8	14.0	14.2	14.5	14.5	14.9	15.2	15.9	16.3	16.6	17.3
200	None	20.4	20.8	21.2	21.6	22.0	22.3	22.7	23.1	23.5	23.8	24.2	25.0	25.8	26.6	27.3	28.4
	10%	18.4	18.7	19.1	19.4	19.8	20.1	20.4	20.8	21.2	21.4	21.8	22.5	23.2	23.9	24.6	25.6
	20%	16.4	16.6	17.0	17.2	17.6	17.9	18.1	18.5	18.9	19.0	19.4	20.0	20.6	21.2	21.9	22.8
	30%	14.4	14.5	14.9	15.0	15.4	15.7	15.8	16.2	16.6	16.6	17.0	17.5	18.0	18.5	19.2	20.0
250	None	25.6	26.0	26.5	27.0	27.4	27.9	28.4	28.9	29.4	29.8	30.3	31.2	32.2	33.1	34.1	35.5
	10%	23.0	23.4	23.9	24.3	24.7	25.1	25.6	26.0	26.5	26.8	27.3	28.1	29.0	29.8	30.7	32.0
	20%	20.4	20.8	21.3	21.6	22.0	22.3	22.8	23.1	23.6	23.8	24.3	25.0	25.8	26.5	27.3	28.5
	30%	17.8	18.2	18.7	18.9	19.3	19.5	20.0	20.2	20.7	20.8	21.3	21.9	22.6	23.2	23.9	25.0
300	None	30.6	31.2	31.8	32.4	32.9	33.5	34.1	34.6	35.2	35.8	36.4	37.5	38.6	39.8	40.9	42.7
	10%	27.5	28.1	28.6	29.2	29.6	30.2	30.7	31.1	31.7	32.2	32.8	33.8	34.7	35.8	36.8	38.4
	20%	24.4	25.0	25.4	26.0	26.3	26.9	27.3	27.6	28.2	28.6	29.2	30.1	30.8	31.8	32.7	34.1
	30%	21.3	21.9	22.2	22.8	23.0	23.6	23.9	24.1	24.7	25.0	25.6	26.4	26.9	27.8	28.6	29.8
350	None	35.8	36.4	37.1	37.8	38.4	39.1	39.7	40.4	41.0	41.8	42.4	43.7	45.0	46.4	47.8	49.8
	10%	32.2	32.8	33.4	34.0	34.6	35.2	35.7	36.4	36.9	37.6	38.2	39.3	40.5	41.8	43.0	44.8
	20%	28.6	29.2	29.7	30.2	30.8	31.3	31.7	32.4	32.8	33.4	34.0	34.9	36.0	37.2	38.2	39.8
	30%	25.0	25.6	26.0	26.4	27.0	27.4	27.7	28.4	28.7	29.2	29.8	30.1	31.5	32.6	33.4	34.8
400	None	40.9	41.6	42.4	43.1	43.8	44.6	45.4	46.2	46.9	47.7	48.4	50.0				
	10%	36.8	37.4	38.2	38.8	39.4	40.1	40.9	41.6	42.2	43.0	43.6	45.0				
	20%	32.7	33.2	34.0	34.5	35.0	35.6	36.4	37.0	37.5	38.3	38.8	40.0				
	30%	28.6	29.0	29.8	30.2	30.6	31.1	31.9	32.4	32.8	33.6	34.0	35.0				
450	None	45.9	46.8	47.6	48.5	49.4	50.2										
	10%	41.3	42.1	42.8	43.6	44.5	45.2										
	20%	36.7	37.4	38.0	38.8	39.6	40.2										
	30%	32.1	32.7	33.2	34.0	34.7	35.2										

TABLE OF EQUIVALENTS OF NAUTICAL AND STATUTE MILES

The Admiralty Knot—6,080 Feet. 1 Statute Mile—5,280 Feet.

Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles
1.00	1.152	5.75	6.621	10.50	12.091	15.25	17.561	20.00	23.030
1.25	1.439	6.00	6.909	10.75	12.379	15.50	17.848	20.25	23.318
1.50	1.727	6.25	7.197	11.00	12.667	15.75	18.136	20.50	23.606
1.75	2.015	6.50	7.485	11.25	12.955	16.00	18.424	20.75	23.894
2.00	2.303	6.75	7.773	11.50	13.242	16.25	18.712	21.00	24.182
2.25	2.591	7.00	8.061	11.75	13.530	16.50	19.000	21.25	24.470
2.50	2.879	7.25	8.349	12.00	13.818	16.75	19.288	21.50	24.758
2.75	3.167	7.50	8.636	12.25	14.106	17.00	19.576	21.75	25.045
3.00	3.455	7.75	8.924	12.50	14.394	17.25	19.864	22.00	25.331
3.25	3.742	8.00	9.212	12.75	14.682	17.50	20.152	22.25	25.562
3.50	4.030	8.25	9.500	13.00	14.970	17.75	20.439	22.50	25.909
3.75	4.318	8.50	9.788	13.25	15.258	18.00	20.727	22.75	26.197
4.00	4.606	8.75	10.076	13.50	15.545	18.25	20.015	23.00	26.485
4.25	4.894	9.00	10.364	13.75	15.833	18.50	21.303	23.50	27.061
4.50	5.182	9.25	10.652	14.00	16.121	18.75	21.591	24.00	27.636
4.75	5.470	9.50	10.939	14.25	16.409	19.00	21.879	24.50	28.212
5.00	5.758	9.75	11.227	14.50	16.697	19.25	22.167	25.00	28.788
5.25	6.045	10.00	11.515	14.75	16.985	19.50	22.455		
5.50	6.333	10.25	11.803	15.00	17.273	19.75	22.742		

TIME AND SPEED TABLE

If You Know the Speed of Your Boat Over a Statute or Nautical Mile, This Table Shows the Corresponding Speed in Statute or Nautical Miles Per Hour

Secs.	1 min.	2 min.	3 min.	4 min.	5 min.	6 min.	7 min.	8 min.	9 min.	10 min.	11 min.	12 min.	13 min.	14 min.
0	60.000	30.000	20.000	15.000	12.000	10.009	8.571	7.500	6.667	6.000	5.455	5.000	4.615	4.286
1	59.016	29.752	19.890	14.938	11.960	9.972	8.551	7.484	6.654	5.990	5.446	4.993	4.609	4.281
2	58.064	29.508	19.780	14.876	11.921	9.945	8.531	7.469	6.642	5.980	5.438	4.986	4.604	4.275
3	57.143	29.268	19.672	14.815	11.881	9.917	8.511	7.453	6.630	5.970	5.430	4.979	4.598	4.270
4	56.250	29.032	19.565	14.754	11.842	9.890	8.491	7.438	6.618	5.960	5.422	4.972	4.592	4.265
5	55.384	28.800	19.459	14.694	11.803	9.863	8.471	7.428	6.606	5.950	5.414	4.965	4.586	4.260
6	54.545	28.571	19.355	14.634	11.765	9.836	8.451	7.407	6.593	5.941	5.405	4.959	4.580	4.255
7	53.731	28.346	19.251	14.575	11.726	9.809	8.431	7.392	6.581	5.931	5.397	4.952	4.574	4.250
8	52.941	28.125	19.149	14.516	11.688	9.783	8.411	7.377	6.569	5.921	5.389	4.945	4.568	4.245
9	52.174	27.907	19.048	14.458	11.650	9.756	8.392	7.362	6.557	5.911	5.381	4.938	4.563	4.240
10	51.428	27.692	18.947	14.400	11.613	9.730	8.372	7.347	6.545	5.902	5.373	4.931	4.557	4.235
11	50.704	27.481	18.848	14.343	11.576	9.704	8.353	7.332	6.534	5.892	5.365	4.925	4.551	4.230
12	50.000	27.273	18.750	14.286	11.538	9.677	8.333	7.317	6.522	5.882	5.357	4.918	4.545	4.225
13	49.315	27.068	18.653	14.229	11.502	9.651	8.314	7.302	6.510	5.873	5.349	4.911	4.540	4.220
14	48.648	28.866	18.557	14.173	11.465	9.626	8.295	7.287	6.498	5.863	5.341	4.905	4.534	4.215
15	48.000	26.667	18.461	14.118	11.429	9.600	8.276	7.273	6.486	5.854	5.333	4.898	4.528	4.210
16	47.368	26.471	18.367	14.062	11.392	9.574	8.257	7.258	6.475	5.844	5.325	4.891	4.523	4.206
17	46.753	26.277	18.274	14.008	11.356	9.549	8.238	7.243	6.463	5.835	5.318	4.885	4.517	4.201
18	46.154	26.087	18.182	13.953	11.321	9.524	8.219	7.229	6.452	5.825	5.310	4.878	4.511	4.196
19	45.570	25.899	18.090	13.900	11.285	9.499	8.200	7.214	6.440	5.816	5.302	4.871	4.506	4.191
20	45.000	25.714	18.000	13.846	11.250	9.474	8.182	7.200	6.429	5.806	5.294	4.865	4.500	4.186
21	44.444	25.532	17.910	13.793	11.215	9.449	8.163	7.186	6.417	5.797	5.286	4.858	4.494	4.181
22	43.902	25.352	17.822	13.740	11.180	9.424	8.145	7.171	6.406	5.788	5.279	4.852	4.489	4.176
23	43.373	25.175	17.734	13.688	11.146	9.399	8.126	7.157	6.394	5.778	5.271	4.845	4.483	4.171
24	42.857	25.000	17.647	13.636	11.111	9.375	8.108	7.143	6.383	5.769	5.263	4.839	4.478	4.167
25	42.353	24.828	17.561	13.585	11.077	9.351	8.090	7.129	6.372	5.760	5.255	4.832	4.472	4.162
26	41.860	24.658	17.476	13.534	11.043	9.326	8.072	7.115	6.360	5.751	5.248	4.826	4.468	4.157
27	41.379	24.490	17.391	13.483	11.009	9.302	8.054	7.101	6.349	5.742	5.240	4.819	4.461	4.152
28	40.909	24.324	17.308	13.433	10.976	9.278	8.036	7.087	6.338	5.732	5.233	4.813	4.455	4.147
29	40.450	24.161	17.225	13.383	10.942	9.254	8.018	7.073	6.327	5.723	5.225	4.806	4.450	4.143
30	40.000	24.000	17.143	13.333	10.909	9.231	8.000	7.059	6.316	5.714	5.217	4.800	4.444	4.138
31	39.561	23.841	17.062	13.284	10.876	9.207	7.982	7.045	6.305	5.705	5.210	4.794	4.439	4.133
32	39.130	23.684	16.981	13.235	10.843	9.184	7.965	7.031	6.294	5.696	5.202	4.787	4.433	4.128
33	38.710	23.529	16.901	13.187	10.811	9.160	7.947	7.018	6.283	5.687	5.195	4.781	4.428	4.124
34	38.298	23.377	16.822	13.139	10.778	9.137	7.930	7.004	6.272	5.678	5.187	4.774	4.423	4.119
35	37.895	23.226	16.744	13.091	10.746	9.114	7.912	6.990	6.261	5.669	5.180	4.768	4.417	4.114
36	37.500	23.077	16.667	13.043	10.714	9.091	7.895	6.977	6.250	5.660	5.172	4.762	4.412	4.110
37	37.113	22.930	16.590	12.996	10.682	9.068	7.877	6.963	6.239	5.651	5.165	4.756	4.406	4.105
38	36.735	22.785	16.514	12.950	10.651	9.045	7.860	6.950	6.228	5.643	5.158	4.749	4.401	4.100
39	36.364	22.642	16.438	12.903	10.619	9.023	7.843	6.936	6.218	5.634	5.150	4.743	4.396	4.096
40	36.000	22.500	16.364	12.857	10.588	9.000	7.826	6.923	6.207	5.625	5.143	4.737	4.390	4.091
41	35.644	22.360	16.290	12.811	10.557	8.978	7.809	6.910	6.196	5.616	5.136	4.731	4.385	4.086
42	35.294	22.222	16.216	12.766	10.526	8.955	7.792	6.894	6.186	5.607	5.128	4.724	4.379	4.082
43	34.951	22.086	16.143	12.721	10.496	8.933	7.775	6.883	6.175	5.599	5.121	4.718	4.374	4.077
44	34.615	21.951	16.071	12.676	10.465	8.911	7.759	6.870	6.164	5.590	5.114	4.712	4.369	4.072
45	34.286	21.818	16.000	12.632	10.435	8.889	7.742	6.857	6.154	5.581	5.106	4.706	4.364	4.068
46	33.962	21.687	15.929	12.587	10.405	8.867	7.725	6.844	6.143	5.573	5.099	4.700	4.358	4.063
47	33.644	21.557	15.859	12.544	10.375	8.845	7.709	6.831	6.133	5.564	5.092	4.693	4.353	4.059
48	33.333	21.429	15.789	12.500	10.345	8.824	7.692	6.818	6.122	5.556	5.085	4.687	4.348	4.054
49	33.028	21.302	15.721	12.457	10.315	8.802	7.676	6.805	6.112	5.547	5.078	4.681	4.343	4.049
50	32.727	21.176	15.652	12.414	10.286	8.780	7.660	6.792	6.102	5.538	5.070	4.675	4.337	4.045
51	32.432	21.053	15.584	12.371	10.256	8.759	7.643	6.780	6.091	5.530	5.063	4.669	4.332	4.040
52	32.143	20.930	15.517	12.329	10.227	8.738	7.627	6.767	6.081	5.521	5.056	4.663	4.327	4.035
53	31.858	20.809	15.451	12.287	10.198	8.717	7.611	6.754	6.071	5.513	5.049	4.657	4.322	4.031
54	31.579	20.690	15.385	12.245	10.169	8.696	7.595	6.742	6.061	5.505	5.042	4.651	4.316	4.027
55	31.304	20.571	15.319	12.203	10.141	8.675	7.579	6.729	6.050	5.496	5.035	4.645	4.311	4.022
56	31.034	20.455	15.254	12.162	10.112	8.654	7.563	6.716	6.040	5.488	5.028	4.639	4.300	4.018
57	30.769	20.339	15.190	12.121	10.084	8.633	7.547	6.704	6.030	5.479	5.021	4.633	4.301	4.013
58	30.508	20.225	15.126	12.081	10.056	8.612	7.531	6.691	6.020	5.471	5.014	4.627	4.296	4.009
59	30.252	20.112	15.063	12.040	10.028	8.592	7.516	6.679	6.010	5.463	5.007	4.621	4.291	4.004

Style B. Fig. 60
Columbian Towing Propeller
For description see page 18.

EXPLANATION OF TABLE OF PROPELLERS

This table is to aid the motorboat owner or builder in selecting the proper Columbian Propeller. It is based on experience with Columbian Propellers with engines not over-rated (based upon about 65 lbs. mean effective pressure) and shows the power of engine necessary to turn the propeller selected a certain number of r. p. m. It shows for each horsepower and engine speed a propeller for one type of boat. The propeller shown may be used as a basis upon which to determine propellers for other types with the same power, bearing in mind that a low pitch ratio is suitable for heavy boats and a high pitch ratio for speed boats. The first figure indicates the diameter and the second figure the pitch, thus 18 x 20 means a propeller 18 inches diameter with 20 inches pitch. The table covers three-blade propellers only. A two-blade propeller should usually be about two inches larger in diameter to hold the motor the same as a three-blade propeller of the same pitch and style.

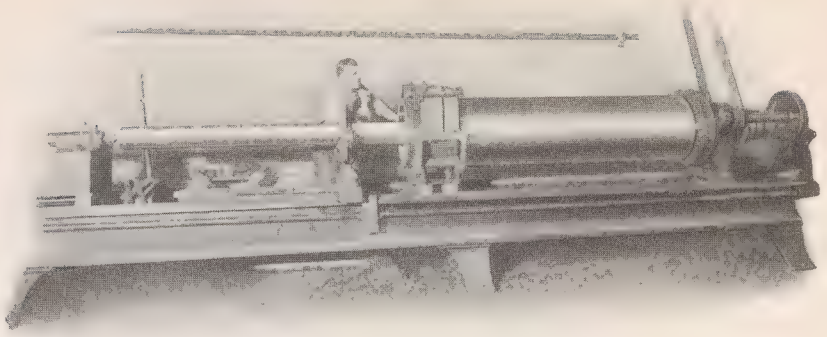
The table is based upon Styles "A" or "G" three-blade, or Style "C" two-blade Columbian Propellers except for propellers larger than 36 inches in diameter, when Style "B" Towing Propellers are referred to. Style "E" Elliptical Blade Propellers of the same diameter and pitch will generally allow the motor from thirty to fifty revolutions more per minute, while Style "F" Columbian Architects Propellers generally hold the motors to about thirty revolutions less per minute than the Style "A." Style "I" Propellers at 300 r. p. m. turn about ten revolutions less than Style "A" and at 600 r. p. m. turn about twenty revolutions less. Style "H" propellers turn about twenty revolutions less than Style "A" at 300 r. p. m. and at 600 r. p. m. turn about forty revolutions less.

TABLE OF PROPELLERS

(For Explanation See Page 46)

Three-Blade Columbian Propellers

Horse Power	REVOLUTIONS PER MINUTE												
	300	350	400	450	500	600	700	800	900	1000	1100	1200	1400
2	18x20	14x21	14x19	14x17½	12x18	12x12	10x12½						
3	18x26	16x24	16x20	14x19	14x17½	12x17	10x15	10x12½					
4	20x26	18x26	18x22½	16x20	16x18	14x17½	12x15	10x15	10x12½				
5	20x30	20x24	20x20	18x20	16x20	16x16	14x15	12x15	10x15				
6	22x24	20x29	20x25	18x24	18x19	16x18	14x16	12x16	12x15				
7	22x30	22x22	18x30	18x27	18x22	16x20	16x16	14x15	12x16	12x13			
8	24x30	22x27½	20x27	20x25	18x25	16x22	16x19	14x16	14x14	12x14	12x12		
10	26x30	24x28	22x27½	20x27	18x28	16x26	16x23	16x16	14x15	12x15	12x13		
12	28x28	26x30	24x26	22x24	20x25	18x25	18x22	16x19	14x18	14x14	12x14		
14	28x30	28x28	26x30	24x24	22x24	20x23	16x25	16x21	14x19	14x16	12x15		
16	30x30	28x30	28x28	26x30	24x24	20x25	16x28	16x23	16x18	14x18	14x14		
18	30x33	30x30	28x30	28x28	24x26	22x24	18x28	18x19	16x19	16x17	14x16		
20	30x36	30x33	30x30	28x30	24x28	22x26	18x30	16x26	16x20	16x18	16x16	14x14	
22	30x39	30x36	30x31½	30x30	24x30	22x28	18x32	16x28	16x21	16x19	16x17	14x15	
25	30x42	30x28	30x33	30x31	26x28	22x30	18x33	18x28	16x23	16x20	16x18	14x16	
28	32x37	30x40	30x35	30x32	26x30	24x28	18x34	18x29	18x23	16x22	16x19	14x17½	
30	32x38	32x34	30x37½	30x33	26x32	24x30	20x28	18x30	18x24	16x23	16x21	14x19	
32	32x39	32x35	32x31	30x34	28x30	26x28	20x30	18x31	18x25	18x22½	16x22	14x21	
35	34x39	34x35	32x32	30x35	28x32	26x30	22x30	18x32	18x26	18x24	16x23	16x19	14x14
38	34x40	34x36	34x32	30x36	30x30	24x32	24x26	20x28	18x28	18x25	18x20	16x20	14x15½
40	34x41	34x37	34x33	30x37	30x31	24x34	24x27	20x30	18x30	18x26	18x21	16x21	14x17
42	34x42	34x38	34x34	30x38	30x32	26x32	22x32	20x32	18x32½	18x27	18x22	16x21½	14x18½
45	34x43	34x39	34x35	32x32	30x33	28x30	24x28	20x34	18x34	18x28	18x23	16x22	14x20
50	38x38	36x36	36x33	32x34	30x35	26x36	24x30	22x31	18x36	18x30	18x24	16x24	16x17½
55	38x40	36x38	36x34	34x32	30x37	28x34	26x32	22x32	20x35	18x31	18x26	18x21	16x19
60	40x38	38x36	36x35	34x34	30x39	28x36	26x33½	24x29	20x37½	20x31	18x28	18x22	16x21
65	40x40	38x38	36x36	34x36	32x33	28x38	28x30	24x30	22x30	20x32½	18x30	20x21	16x22
70	40x42	38x40	38x36	36x34	34x32	30x32	28x31	22x35	22x32½	20x34	20x28	20x22½	18x20
75	42x42	40x38	38x38	36x36	34x34	30x34	28x32	22x36	22x34	20x36	20x29	20x24	18x21
80	44x42	40x40	38x40	36x38	34x36	30x36	28x34	22x37	20x43	20x38	20x30	18x29½	18x22
85	44x44	40x42	40x38	38x36	36x34	32x32	30x28	24x34	22x35½	22x30	18x37	18x31	18x22½
90	46x44	42x42	40x40	38x38	36x36	32x34	30x30	26x33	22x36	22x30½	20x34	18x32	18x23
95	46x46	44x42	42x40	38x40	36x38	34x32	30x32	26x34	22x36½	22x31	20x35	20x29	18x24
100	48x46	44x44	42x42	40x38	38x38	34x34	32x30	26x36	22x38	22x32	22x26½	20x30	18x25



Engine Lathe with 30-foot bed machining propeller shaft liner for Emergency Fleet Ship. This liner weighed 2,750 pounds.

CASTINGS

The exceptional quality of Columbian Propellers has caused many of our satisfied customers to request prices for bronze castings in such quantity that we have developed a large general castings business.

Manganese Bronze Castings

Originally our castings business was confined principally to Columbian Manganese Bronze, the properties of which are described on page 9, and castings are made of that metal from a few ounces up to 5,000 pounds. Our castings business has, however, naturally developed into a specialty in making

Difficult Castings

We manufacture castings which the ordinary foundry cannot make, or which are subject to careful chemical analysis, or which must be particularly smooth or homogeneous, or castings with particular qualities, such as acid-resisting. We make, however, a large volume of ordinary bronze castings but specialize more in the heavier weights.

Copper Castings

During the past year we have made a large quantity of copper castings, some of which were made to very rigid specifications, on which three other foundries had failed. This consisted of copper tubes 7 inches inside diameter, 7 feet, 6 inches long, having an electrical conductivity of 80 per cent that of pure copper or better; the castings to stand a hydraulic pressure of 80 pounds per square inch. Our experience in this line enables us to handle practically anything in the line of copper castings.

Inquiries are solicited for all classes of bronze and copper castings.

SHIPS BELLS

	1st Watch	Middle Watch	Morning Watch	Forenoon Watch	Afternoon Watch	1st Dog Watch 4 to 6 2nd Dog Watch 6 to 8
1 Bell	8:30 P.M.	12:30 A.M.	4:30 A.M.	8:30 A.M.	12:30 P.M.	4:30 P.M.
2 "	9:00 "	1:00 "	5:00 "	9:00 "	1:00 "	5:00 "
3 "	9:30 "	1:30 "	5:30 "	9:30 "	1:30 "	5:30 "
4 "	10:00 "	2:00 "	6:00 "	10:00 "	2:00 "	6:00 "
5 "	10:30 "	2:30 "	6:30 "	10:30 "	2:30 "	6:30 "
6 "	11:00 "	3:00 "	7:00 "	11:00 "	3:00 "	7:00 "
7 "	11:30 "	3:30 "	7:30 "	11:30 "	3:30 "	7:30 "
8 "	12:00 "	4:00 "	8:00 "	12:00 M.	4:00 "	8:00 "

Propellers in a nut shell

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Columbian Bronze Corp. pub.